THE MANUFACTURE OF PAPER CONTAINERS

A Text-Book on Paper Box and Bag Making

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It should be understood that these illustrations have not been chosen to denote any special make of machine, but only as an indication of its general appearance. Of almost every kind shown many of the recognised engineering concerns produce their own distinct variety for the same operation, and the pictures in this volume are not intended to depict which machine is the best for the work to be done.

It should also be noted that the use of the word "container" in this volume is made in its generic sense, as the term embracing all kinds of paper packages, whether boxes or bags.

THE MANUFACTURE OF PAPER CONTAINERS

A Text-Book on Paper Box and Bag Making

BY

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The Manufacture of Paper Containers.

SYNOPSIS.

§ 1

THE RAW MATERIAL.

THOUGH the construction of receptacles out of paper and cardboard for public use has been known for over a century in both the Eastern and Western Hemispheres, it is only during the past fifty years that well-defined businesses engaged in their manufacture have sprung up. It might even be narrowed down to the last decade since the trade has deservedly secured a position of importance in the industrial life of Western Europe and North America. Some of the earliest specimens of paper receptacles in existence are the band boxes of the seventeenth and early eighteenth centuries on view at certain museums. These band boxes were made for ladies of fashion for travelling purposes, and were covered with wallpaper of a flowered pattern.

The raw material used for the manufacture of these boxes was known as scale-board or chip-board, which was a thin shaving or veneer of wood, such as is still being used for match box making. The term chip-board has now a different meaning in America, applying to a form of cardboard. Scale-board was, however, supplanted by what was then known as pasteboard, because the processes involved were simply the pasting together of sheets of stout paper and made firm in an ordinary hand press, somewhat similarly to the present manufacture of hand-made millboard. With the need for raw material of other qualities, the word "pasteboard" was used to define a special kind

of board required by manufacturing stationers, and the generic term became "cardboard."

As for paper bags, the earliest types were merely a slight improvement on the ordinary paper coverings used by shopkeepers whenever powdered or granular articles, such as sugar or tea were sold. It was then found more suitable to twist a piece of paper into a cone, and the thin, straw-coloured paper adopted for this purpose was the forerunner of the wrapping paper now in common use. Following the twisted paper cone came the hand made paper bag, and it is an interesting fact that both paper box and bag making began to take firm hold on the industrial life of Europe and North America about the same period. At present many varieties of wrapping paper are used as raw material for paper bag manufacture, as well as other classes of paper, but though the term, "bag paper," may serve broadly to describe them all, it is not generical to the group as cardboard is to the firmer materials used for paper box making.

Of the different kinds of cardboard which are required mainly for the manufacture of rigid and folding paper boxes are strawboard, leatherboard, paperboard, and woodpulpboard. This group is sometimes described as boxboard, though with the development of the trade so many varieties have been produced that in certain branches the term "boxboard" has been applied to a particular series adopted in the making of cartons or folding boxes. Strawboard is, however, by reason of its very extensive use, the chief of the whole group. As its name implies, its principal ingredient is straw pulp. Wheaten or oaten straw, and in some countries rye straw, is taken and digested with lime, after which it is beaten to pulp in the ordinary way.

STRAWBOARD.

Considerable experience is required in the manufacture of strawboard that has a smooth surface, will bend satisfactorily, and will "bulk" well (i.e., offer a maximum of thickness plus tensile strength in ratio to its weight),

because the cells of which the fibre of grasses are composed are short, rather wide in proportion to their length, and thin-walled.. Straw fibres consequently split more readily than those of wood pulp. The chief points for attention in preparing the pulp are the isolation and softening of the fibres by cooking, bleaching, and grinding, without shortening the fibre's naturally inferior length. Great care must be taken with the regulation of the beating, which, if too severe, causes the fibre to split and forms viscous bodies that make the board glassy, brittle, and cockled. Moreover, viscous pulp will produce a board that absorbs moisture from the atmosphere and keeps very badly in stock.

When the pulp or stock is ground and thoroughly washed in the beaters it is pumped to the jordan engine for further grinding. It then flows to a stuff chest, in which an agitator keeps the stock from settling, and later to the stuff box, from which it flows into a mixing vat. The cylinder vat then takes the stock and leaves it in a layer of uniform thickness on the cylinder or wire mould, after which an endless felt squeezes out half of the water, and the pulp is ready for the drying cylinders and calender rolls which produce the finished board. Generally, about seven tons of straw are used to about 18 to 22 bushels of lime dissolved in about 2,000 gallons of water.

European strawboard is made in various sizes and thicknesses from the standard size, 22 by 32 inches to 30 by 40 inches superficial, and in varying thicknesses from 4 ozs. to 4 lbs. to the sheet. It is sold by weight, either unlined—that is, without paper being pasted to one or both sides—or lined with glazed or unglazed paper in white or different tints. A few mills have facilities for the manufacture of straw paper, prepared similarly to the board, but much thinner and more pliable, from which corrugated board and paper tubes can be made.

Leatherboard.

Leatherboard derived its name from its reddish-brown leather-like appearance and strength, and from the fact that

in some of the better qualities originally made leather scraps were shredded for mixture with the wood fibres in the preparation of the pulp. It is produced in either hand or machine made, glazed and unglazed varieties. The standard size in Europe for leatherboard is 24 by 38 inches, though it is also made in other sizes up to 32 by 45½ inches, and in different thicknesses from .020 to .160 caliper.

A similar board, but not so highly finished, is made in North America, and is composed of a variety of ingredients. For one kind sulphate wood pulp is mixed with pulped waste papers, and for another flax waste or flax straw. Flax waste is derived from retted flax straw, and consequently contains very little of the mucilaginous pectin compounds present in the un-retted kinds. For this reason flax straw requires the use of more chemicals in its reduction than flax waste. The reddish-brown tint is produced in various ways, though a satisfactory method has been the mixture of a few drops of 1 per cent. phenolphthalein in 50 per cent. alcohol with about a quarter of an ounce of the waste liquor.

The machine for making these boards, and indeed for all kinds of cardboard, is similar to the Fourdrinier type for strawboard making, variation being made only in the number of drying cylinders and calender rolls according to the class of board required. For instance, in the manufacture of some kinds of leatherboard, rosin, size, alum and colouring matter are added directly to the beaters.

Paperboard.

Practical economy may be said to be the cause of the origination of paperboard, the manufacture of which has developed to a considerable extent in both the British Isles and North America, during the past ten years. As its name signifies, its principal ingredient is waste paper. Sometimes this is mixed with wood pulp, bagging or straw to give it different consistencies. The general process of manufacture of this class of cardboard is similar to that of strawboard, except that no lime is required for the cooking or digesting

operation, and that the half-stuff requires much less working. Care must be taken in the choice of the waste board or paper used, because its re-pulping cannot be repeated indefinitely; since the fibres are broken a little shorter by each successive treatment, and the resulting board becomes so much denser, heavier, and weaker.

The better qualities of paperboard are sustained by the mixture of a fair proportion of higher-grade wood or straw pulp with the re-beaten paper pulp. Waste paper, however, is a popular raw material, because it assists in increasing output by reducing the time required for treatment in the digesters and beaters, and the loss in pulping is only about 5 per cent., compared with the 30 to 40 per cent. with straw. The addition of other fibrous ingredients, such as rags, bagging, straw, and good "kraft" (stout brown wrapping paper) waste, increases the tensile strength and tenacity of the board. At present the sizes made are not standardised, each mill working to the dimensions of its board machines.

Woodpulpboard.

Woodpulpboard is also used to a considerable extent in the production of the better-class rigid and folding paper containers, and because of the comparative thinness and length of the fibres the board has greater strength and tenacity than either strawboard or paperboard. This bears the advantage over weaker boards that thinner sheets may be employed, and that it is specially adapted for stamping and drawing operations. The processes of manufacture are similar to those which have been described previously.

The pulp for this board is made from the wood of such trees as spruce, larch, maple, and fir, and is manufactured in two ways, resulting in what is known commercially as mechanical and chemical pulp. The latter is much the more expensive of the two, being treated with either sulphuric acid (sulphate pulp) or sulphurous acid (sulphite pulp). European wood pulp boards are made in the standard size, 22 by 32 inches, and in other sizes up to 27½ by

$89\frac{1}{2}$ inches, the boards varying in thicknesses from .009 to .112 caliper.

Thin sheets of either strawboard, leatherboard or paperboard, and chiefly of the latter, are sometimes pasted together to make the product, now in much demand, known as fibreboard. In fact, the principal function of a solid fibreboard mill is to build up a heavy board from the rolls of boxboard. These rolls vary in strength from a weak paper made of waste news and other weak papers to a strong sheet made almost entirely of new pulp. Such a sheet is known in the United States of America as jute board, although jute is seldom actually used at the present time. The tough jute board is used for the outer plies of the solid fibreboard, while body is given by building up the interior with chip sheets. These various component sheets may vary from .016 to .030 inch in thickness, and are combined to form solid fibreboards of three standard sizes, .060, .080, and .1 of an inch thick. The sheets are cemented together in a pasting machine, using silicate of soda as the adhesive.

Corrugated Board.

Corrugated board is generally made from either two or three sheets of straw or some other fibred paper, and possesses special resiliency because of the wave-like shape or corrugations given to one of these sheets of paper. When two sheets are used the result is known as single faced, and with three sheets as double faced corrugated board.

For making single faced corrugated board, therefore, two rolls are used, one receiving the corrugations, which is pasted to the other or lining sheet. The corrugations are made under pressure, and an adhesive is applied to the tops of the corrugations while still in the roll. The lining sheet, which is tempered over a steam-heated roll, is stuck under pressure to the corrugated sheet before it leaves the main corrugating roll. A British-made single faced corrugating machine has now been placed on the market, for which no heat is required and which will make any width

of board up to 86 inches. Its speed is 1,000 feet per hour, and a counter is attached to indicate the exact length made. Only one operator is required, and it occupies a floor space of 5 feet by 4 feet. Single faced corrugated board should weigh to the 1,000 square feet about 60 lbs. for the corrugated sheet, 40 lbs. for the lining sheet, and 10 lbs. for the adhesive.

Machines are also made which will produce either single or double faced corrugated board. One of these machines will produce either single faced board or two webs of the board simultaneously wound into rolls, or delivered cut into sheets and nested with the corrugated sides interlocking. This enables the two sheets to be handled as one for slitting and creasing. The same machine will also produce double faced board in sheets cut accurately to lengths by means of a duplex travelling shear, and it may be equipped with rotary slitters and creasers to trim, slit and crease the sheets in the direction of the length.

WATERPROOFED BOARDS AND PAPER.

For the manufacture of fibreboard packing cases and round food containers, there is a great demand for waterproofed raw material. Various methods for waterproofing food containers are dealt with more fully in a subsequent section*, but for fibreboard (pasted or laminated board) there are three problems to be solved to make it entirely waterproof. Firstly, the paper pulp must be made water resistant by the use of special sizing materials which are added in the beating engine; secondly, the waterproof paper must be pasted in layers by means of a water-soluble substance, as silicate of soda, which becomes insoluble on drying; and thirdly, but of less importance, the surface of the pasted board may be coated with a water-resistant material.

By one method preparatory to dipping or steeping the board in the bath or copper containing a heated impregnating material, the articles are dipped or steeped in a

* See page 195.

solution of casein with or without a quantity of formaldehyde added thereto. In some cases the casein necessary may be added to and mixed with the wax or other material to be heated in the bath or copper for steeping the articles preparatory to their introduction into the drying apparatus or impregnating chamber; or the impregnating solution may consist of wax with a proportion of resinous or resinoid material mixed therewith.

Waterproofed papers have been made by another method of two sheets of thin paper with a layer of pitch between them. Other methods are by impregnation with either wax or oil. Waxing is an expensive process, for the original paper takes up from 10 per cent. to 40 per cent. of wax in the process, and the strength of the product is generally reduced about 20 per cent. Oiled paper has a limited use, owing to the difficulty of keeping the oil in the paper after it is put there. This paper is used a lot in the packing industry.

Box Papers.

In the covering of cardboard for the production of paper boxes the two papers chiefly used are flints and enamels. The former paper derived its name from the original process of polishing by means of flint stones worked by hand. Machinery has now replaced this process. Both flint and enamel papers are supplied in standard sizes of sheets, and in some cases in rolls. They can be obtained in white or black or in any tint, polished or glazed to varying degrees, and finished plain, embossed, or to represent watered silk.

Some very high-class decorative papers are produced in France, and, in addition to these, Great Britain manufactures cover papers for boxes of very artistic appearance. These are known commercially by various names, such as imitation leatherette, crocodile, lace, fancy wrappings, goldfoil, tinfoil, gold bronze, etc., papers, and to them must be added the plain book papers and linings for the insides of the boxes.

The other materials used for the manufacture of rigid and folding paper boxes are, in order of importance, corner staying paper (which is glued and made of stout brown paper or sometimes of paper with calico threads intertwined); adhesives (such as cake and ground glue which have to be heated, and cold glues, gums, and pastes which only require mixing with water); stitching wire (supplied in varying thicknesses for fastening the corners of boxes); and bronze, aluminium, and blocking powders, etc. (used for the decoration of box exteriors).

Bag Papers.

Most paper bags are made from sulphite and nature papers, either machine glazed (M.G.) on one or on both sides. Papers known as M.G. Caps are also used for similar bags, and these three qualities are generally adopted for the manufacture of bags for the flour, biscuit, fruit and similar industries, where a thin but fairly strong package is required. Better class bags, such as for the laundry, millinery, soda, rice, tea, etc., trades, and for such articles as cash, high-grade confectionery and foodstuffs, etc., are made from glazed cartridge, stout kraft, imitation parchment, greaseproof papers, the latter quality being in considerable demand for the lining of bags and other kinds of containers in which foodstuffs are packed. These linings are known in the trade as paper bag inners or liners.

Though many of the principal paper bag making houses adopt different qualities of papers and sizes for similar trades, according to the needs of the custom they have established, such qualities, sizes and tints as the following are generally adopted : For the flour trade, M.G. Sulphite paper, white or buff in colour, for the 1 oz. to 2 lb. sizes, and Kraft or Glazed Cartridge paper for the 3 lb. to 14 lb. sizes, although a very thick tinted Sulphite paper is sometimes used for yellow self-raising flour bags from 1¾ lb. to 5 lb. sizes; similar papers are used for the fruit, sugar and biscuit trades, except that for the sugar trade the paper may be brown, blue, pink, purple, buff or grey

a tint, or best rope; for the confectionery trade, only I.G. papers are used, and for the millinery, laundry, soda nd rice trades good Kraft papers are taken.

M.G. Sulphite paper is used in various weights running rom the very light 24 x 36, 500s, 11 lbs., which is known s "M.G. Sulphite Cap," by thicknesses of 1 lb. per ream p to 24 lbs., which is known as "M.G. Sulphite Wrapping." Lightweight caps are used for millinery and flour ags, the consumption in the British Isles of M.G. Caps lone is believed to be between 40,000 and 50,000 tons per nnum, of which British mills supply about 10,000 tons. lazed imitation parchment is sulphite paper, sold in leached and unbleached qualities.

Whereas these varieties may be suitable for home and ocal trade, it does not follow that they are equally wanted 1 foreign markets. For the export trade, papers are enerally used according to the custom of the country oncerned. For instance, in the Argentine Republic, rocery bags are made from Sulphite paper glazed on one ide and in two colours, pink and yellow. In the same ountry, good class confectionery bags are always lined ith white tissue or thin parchment paper. It is therefore dvisable to obtain specimens of the bags in general use 1 each country before entering that market. Other kinds f bag and wrapping papers required overseas, in addition o the regular lines are white manilla flour bag, M.G., oloured lining, tobacco brown, bottle wrapping, and candle apers.

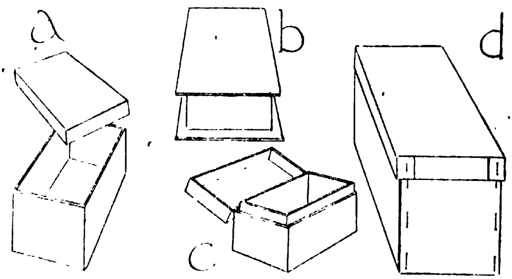
§ 2

MACHINE MADE BOXES.

In all the industries concerned with the manufacture of paper containers that of paper box making is the most important. Though described commercially as "paper" boxes the principal raw material used in their construction is cardboard, paper being used mainly for strengthening and decorating the boxes. These two materials have lent themselves so readily to the production of useful and artistic containers that the demand is constantly increasing. In keeping with this demand there has developed an industry necessitating the employment of a large number of workers and the outlay of a considerable amount of capital.

The vast majority of paper boxes are made almost entirely by machinery, and in the purchase and installation of this machinery the utmost care must be taken that it should be as automatic and labour saving as possible, so as to reduce the costs and yet to add to the productive capacity of the factory. Machine made paper boxes can be classified for manufacturing purposes into five groups: the upright covered box, which is rigid and held together by means of adhesives only; the folding box, or carton, which can be stored in a flat condition when not in use and is held together by means of adhesives; the upright wire stitched box, which is rigid and held together by means of wire pierced through the cardboard; the collapsible wire stitched or taped box, which folds flat when empty and is held together either by wire or gummed tape, or both; and the round box, which is rigid, but of cylindrical or conical shape and held together by adhesives.

In order to obtain the most economical results, waste and unnecessary handling of the raw or finished material must be carefully avoided. Theoretically, the raw material should enter at one end of the factory, and the finished article passed out at the other. To put this into practice as effectively as possible the various machines employed should be installed in such relation to one another that the operations necessary to the construction of the box are performed in sequence. With this object in view the



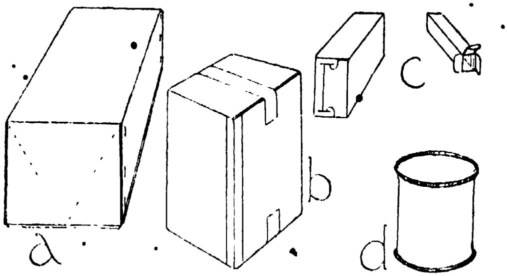
TYPES OF MACHINE MADE BOXES, showing (*a*) upright covered, slip-on lid box; (*b*) upright covered extension edge box; (*c*) upright covered shoulder box; and (*d*) upright wire stitched box.

operations referred to in these pages will be described in sequence, and will form some guide to the factory owner for the installation of his plant.

BOARD LINING.

Machine made boxes are manufactured mostly out of strawboard; paperboard and pulpboard being used generally for containers of good quality. If the box is intended to hold better class goods, such as handkerchiefs, chocolates, etc., it is customary to use a lined board, i.e., a board pasted on one or both sides with book news, or other plain paper. To produce this a board lining machine is required. Its output is large, and for this reason it is installed mainly in factories where a considerable quantity of lined boards are needed.

Several different makes of this machine are obtainable, some of them lining from ten to fifteen thousand sheets of board a day. Mills which supply lined boards generally instal a lining machine which can be attached to the board making machine, so that the entire operation is continuous, but in large box factories the machine is worked independently, the sheets of board and the lining paper from the roll being conveyed together into the machine either in sheets or from the roll. Before they pass through pressure rollers, heated by gas or steam, paste is distributed between the sheets, which are firmly pressed as they pass through



TYPES OF MACHINE MADE BOXES, showing (*a*) collapsible wire stitched box; (*b*) collapsible taped box; (*c*) folding boxes, or cartons; and (*d*) round box.

the machine, the paper being cut off to size, and then both are ejected as a lined board.

These machines are supplied in different sizes, one pattern being built with either five or seven heating rollers forty inches wide, according to the output required. This pattern has an automatic spacer to separate the sheets $\frac{3}{8}$ths of an inch to allow the automatic cut-off to operate. The cut being made from the bottom does not tear the paper from the edge of the board, and the percentage of spoiled sheets is reduced to a minimum. An additional advantage of lining boards is that quite frequently a lighter weight of board may be employed. A man and a boy are required to operate this machine, which should be

worked as near the board stock room as possible. Lined boards can be obtained in small quantities from most of the board manufacturers and merchants.

Of all the various kinds of machine made boxes, perhaps the oldest and most important group is that of the upright covered box, the manufacture of which forms the backbone of the industry. Long before inventive ability was brought to bear upon the production of containers for special needs, the upright covered box had become an essential factor of the trade, and even to this day it holds an established position. For these reasons it is only right that the processes involved in making this class of box should receive first attention.

§ 3

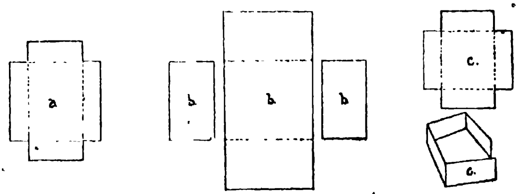
THE UPRIGHT COVERED BOX.

Paper Boxes, which are made firm and upright by means of adhesives alone, are constructed by one of the three following methods: the one-piece box, for which a single sheet of board is used to make the four sides and the bottom; the end-pieced box, in which two sides and the bottom are made from one piece and the two ends (the remaining sides) from a separate piece of board each; and the shoulder box, in which the outside is made as a one-piece box, and the four sides which form the shoulder or neck are made from another piece of board.

The one-piece method is generally adopted for small, shallow boxes, such as would be used to contain chocolates, soap, collars, etc., of not more than about three inches in depth. The principal virtue of the end-pieced method is that it saves waste in board, it being adopted in consequence for deep boxes, such as are used to contain millinery. The shoulder box method is not required so frequently being used mainly for the shallow kind of package to contain such articles as cigarettes, medicines, etc.

Each of these methods refer to the manufacture of the box body; the manner of making the lids for all three varieties being that of the one-piece method if they be shallow, or the end-pieced method if they be deep. The lids for shoulder boxes are sometimes hinged to the box body, the hinge being formed by a label or portion of the

covering paper. When the sheet of board is formed by any of these or other methods into the shape from which the box is constructed, the shaped piece of board, cut to size and ready for folding or "breaking-up," is known as the box blank.



Examples of Upright Covered Box Blanks, showing (*a*) for the one-piece box body; (*b*) for the end-pieced box body; (*c*) for the shoulder box body; the dotted lines representing the score lines.

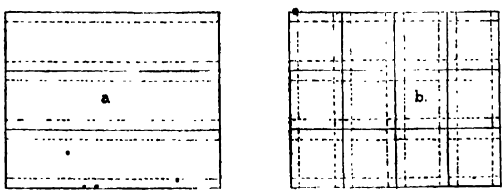
Preparing the Blank.

To prepare the blank for the upright covered box, the first operation on the sheets of board involves their being cut to the size required and scored where they are to be folded. This operation is performed on a cutting and scoring machine, the earlier types of which were made with separate shear knives for cutting and individual cutters operating on a roller for scoring. The process of setting up was lengthy and being gear driven the speed of the machine was comparatively slow. With the modern cutting and scoring machine, full-sized sheets of board are fed into it, and cut and scored to the proper dimensions in passing over one direct-driven roller on which the cutting and scoring knives operate at the same time.

These knives, or rotary cutters, serve equally for either cutting or scoring. For the former operation they are set almost to touch the roller in order to separate the board entirely, and for the latter operation they are raised slightly so that they score the sheet only instead of cutting completely through it. The scoring being done at the highest point of the roll, it ensures good work and no

damage to the board. It has been argued that this method of cutting on to the roller will soon result in it being rendered unserviceable. In practice it has been proved that with ordinary care the necessity for returning the roller to be turned down in a lathe does not arise for more than once in about twelve months, or even longer, with heavy usage. The extra production given by the machine will more than repay this cost.

Scoring and cutting machines are procurable which cut and score the sheet one or both ways. The former is known as the single scorer, and in small and medium sized plants it is sufficient for all requirements, while in big factories it is essential for short runs and "rush" orders. The double scoring and cutting machine is the more rapid and serviceable because it scores and cuts the board in both directions at one handling, and on moderately large orders the time saved by employing this machine is considerable. The work produced is perfectly square and, though the cut in passing the first portion of the machine does not entirely sever the blanks, it nearly separates them so that the worker, in picking the sheets



A Sheet of Board Cut and Scored, showing (*a*) by the single cutting and scoring machine; (*b*) by the double cutting and scoring machine.

up from the receiving table, breaks them apart with a slight jerk. Either of these machines will carry the board through as fast as the operators can feed the sheets, a quite good output being about forty sheets a minute. General experience has proved that for an average worker,

fifteen minutes should be allowed for setting a single scoring machine and thirty minutes for a double scorer.

For thick boards, such as weigh two lbs. to the sheet and are used for boxes to contain heavy articles, the combined slitting and scoring machine has been found preferable. As the board is fed into this machine it comes first under the operation of the scoring cutters and then under that of the slitting cutters. It ensures accuracy in both operations, the feed rolls, which are provided both in front and rear of the slitting shafts, holding the sheet of board firmly so that an absolute straight and clean cut can be obtained. A machine which is specially adapted for light and medium-weight necks, that is where boxes are glued up in sheets and cut off for the height, cutting the two thicknesses at once, is the light rotary cutting machine. These necks, or the sheets, may be fed through the machine very rapidly. With all these and other cutting machines it is advisable that they should be installed in a room away from the glue or covering room so that the dust caused by cutting and scoring is confined to that department. It should be also noted that all these machines are driven by power.

Forming the One-Piece Box.

The operations of scoring and cutting just described prepare the sheet of board into a box blank. When the box body is of the shallow variety which enables it to be made preferably in one piece, the superfluous corners of the blank adjoining the sides require to be cut out. For this operation the corner cutting machine is used, and when this is done the blank is ready for breaking-up by hand or flange bending, staying and covering. Corner cutting machines are made to cut one, two, or four corners at a time. Single corner cutting machines are adapted to all classes of work from lightest to heaviest, deep or shallow cutting. They are made generally with an efficient treadle-operated clutch, which may be locked down for continuous running, or tripped for each cut, in which case the head

always stops at the top of the stroke. The machines are adjustable also for different sizes of cut. As with the single corner cutting machine, knives are obtainable to cut square corners, mitreing, one-piece wrap, extension edge, as well as combinations of the square corner cut with each of the others. The uses of the other corner cuts referred to will be explained later, as the formation of the different kinds of boxes are described.

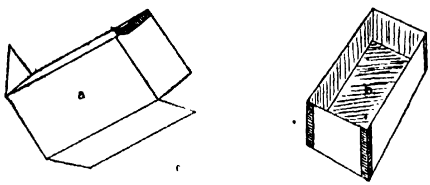
Perhaps the most remarkable of the corner cutting machines is that which cuts the four corners in one operation, and delivers the blanks ready for any of a variety of further processes. This quadruple machine feeds the scored material automatically, delivering and stacking the cut work into the hopper. It can be adjusted to feed and cut the blanks two at a time and deliver them flat in readiness for quadruple corner staying, or an attachment can be added to bend the sides or flanges of the blank in readiness for a single corner staying machine or other operations. When the boxes are shallow this will be found to be an advantage. For flat work from 10,000 to 12,000 pieces an hour can be produced, but for bent work the output is reduced by half. One worker can handle the material for and look after two of these machines.

When shallow boxes are required and a quadruple corner cutting machine is not used, or for boxes with mitred edges, an automatic feed flange bending machine will break up the sides or flanges neatly in readiness for the subsequent process. As a general rule, however, this machine is not essential as the breaking up of the blanks is easily done by hand while the corner cut blanks are being taken to the corner staying machines. It should be here mentioned that the offcuts of board and similar pieces of waste material which result from these cutting operations tend to check the speed of the work performed if they are allowed to gather in a heap round the cutting machine. Arrangements should be made to have this waste removed at frequent periods and baled tightly in one of the well-known makes of baling press. This suggestion will apply

equally in all instances where paper or board cutting is performed.

Corner Staying.

After the blank is cut and scored to size and corner cut, it is ready to be formed into the box body or lid, on the corner staying machine. It is claimed for this operation that it makes the box exceptionally strong since the sides of the box and the stay paper are welded together under great pressure, forming a corner stronger than the board used. By this method the board is neither punctured nor weakened, and the paper stay will not discolour nor damage the contents of the box in any way. Moreover, a big output is thereby possible and a uniform quality of production.



Corner Staying, showing (a) staying one corner of the box; (b) the four corners of the box stayed.

Staying machines are obtainable for fastening one corner at a time, or all the four corners in one operation. Different sizes of single corner staying machines are built from those for shallow boxes and lids to those upon which hosiery and shoe boxes can be stayed. The staying material generally used is a stout brown paper (kraft), gummed on one side, and usually supplied in coils $\frac{3}{4}$ inch in width. With the single corner staying machine the gummed side of the stay paper is fed forward automatically over a moistening device and, as the blank is held together at the corner on the anvil of the machine, depressing the treadle causes the clutch to engage. The head of the

machine descends on to the anvil and fixes the paper stay with heavy pressure, the strip having been cut off to correct length automatically. For changing work about fifteen minutes for setting should be allowed.

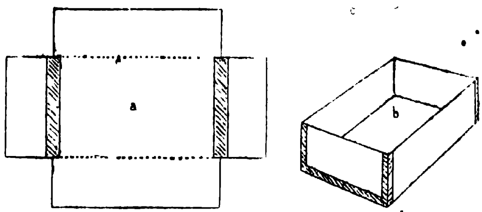
The quadruple corner staying machine is now built to be entirely automatic, so that one worker can look after two machines. A forme which corresponds with the size of the lid or box to be set up is chosen and bolted to the plunger, the side and end guides also being adjusted. Four coils of staying material are placed over their respective moistening and feeding devices, and a pile of scored and corner cut blanks is placed into the hopper. By operating a lever shallow boxes or lids are stayed at all four corners and delivered at the rear end of the machine about 40, or even more, a minute. About thirty minutes setting time should be allowed for this machine. If the stayed box is small it can be delivered into a basket under the delivery band, ready for the covering operations.

FORMING THE END-PIECED BOX.

There are two varieties of end-pieced boxes, those for which the three pieces of board which comprise the box blank are fastened together by means of stay paper, and those for which the piece that forms the bottom and two of the sides are scored to form mitred flanges to which are pasted the two remaining ends. For the former kind, after the blank is cut and scored, the operations involved in forming the box are end-piecing and corner staying. When the ends of the blank are pieced on it has the same shape as a corner cut blank, and is then ready for corner staying.

This work can be done on a single corner staying and end-piecing machine, which applies a stay strip along the bottom of the box and attaches the loose ends (the two remaining sides) to the bottom. Extra parts and gauges are provided to enable the operator to hold the bottoms and ends quickly and accurately in position. When this is done, the same machine will also stay the corners of the

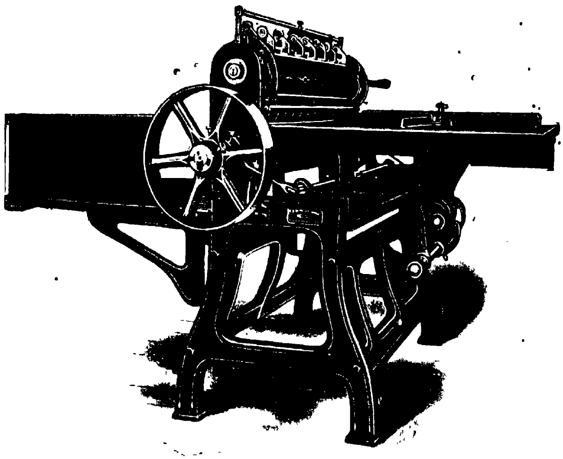
box, which forms it completely. For large outputs the machine can be used for end piecing only, and the corner stays can be applied by the quadruple corner staying machine. If the box does not require covering, and is meant to contain very heavy articles, the corner stays can be attached with a small part of the strip turned over and fixed inside the box. This operation is done on a turn-in corner staying machine, but the increasing demand for covered boxes, which thus receive additional strength at the corners, plus the excellent work now done by the plain corner staying machine, has obviated the need of this operation considerably.



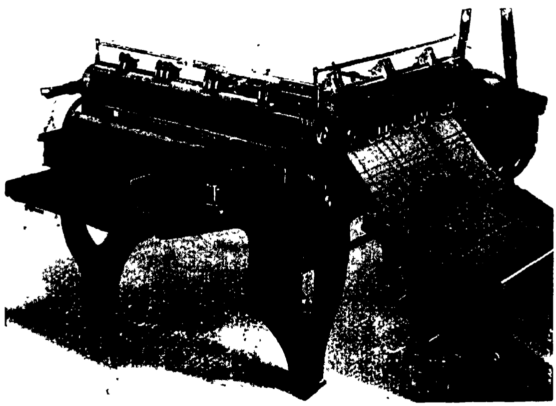
THE END-PIECED BOX, showing (*a*) the scored blank with the two ends pieced-on with stay paper; (*b*) the box body after end-piecing and corner staying.

In the second variety of end-pieced box, or, as it is sometimes termed, the end-set box, the body blank is scored to provide the three parallel strips, of which the middle one forms the bottom of the box and the two outer ones the sides. At the same time it is cross scored near the ends to form narrow flanges upon which the end pieces (the two remaining sides) are to be pasted. These flanged ends are mitred on the corner cutting machine to allow for the rectangular bend. The blank is then ready for end setting, and for this operation the double end setting machine breaks up the blank on the score line, then pastes the outer faces of the flanges, and finally sticks the end blanks upon the pasted flanges, holding the box under great pressure for an instant until the paste sets. The finished

Types of Cutting and Scoring Machines.

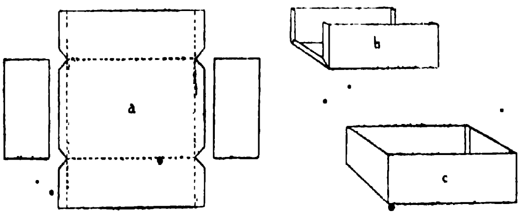


Single Cutting and Scoring Machine.



Double Machine, showing sheet of cut and scored board.

box then drops upon an endless moving band, which conveys it to the rear of the machine. Single end setting machines are also obtainable, and the time allowance for setting these and the double ending machines is about thirty minutes. When the box has its ends set it is ready for covering.



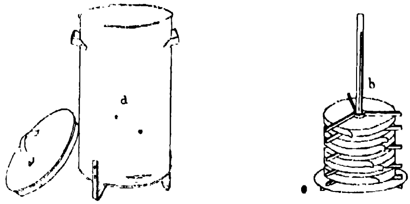
THE END SET BOX, showing (a) the blank scored, cross-scored and mitred, with the two end pieces; (b) the middle portion broken up, the mitred flanges of which are pasted; (c) the box body formed.

PRESERVING GUMMED PAPER.

Users of corner stay paper and sealing paper tape, when the latter are stored in dry places, may find that the moisture has been taken out of the paper to such an extent that it will not work properly. To overcome this difficulty an appliance known as a humidor can be used. It is a galvanized iron cylinder constructed to take a height of rolls and separators up to 21 inches and with capacity to hold rolls up to 12 inches in diameter. If the rolls are placed in the humidor over night, they will gather enough moisture to make the stock pliable and the gum susceptible to quick moistening and tempering. In this way material which might otherwise be rejected or wasted is made available with a saving in time, material and trouble.

The lower portion of the humidor is filled with water through an opening. A tube with two long vent slots in it passes from the bottom compartment through the centre of the upper section. The rolls of stay paper or tape being

placed around this and held apart by open racks, saturated air circulates around all the rolls and moisture is taken up by the paper and gum. The reservoir is so arranged that it cannot be filled full enough to cause the water to reach the coils of paper.



THE HUMIDOR for restoring moisture to dried out gummed staying material and sealing paper, showing (*a*) the reservoir and lid; (*b*) the centre tube holder, on which the coils of paper are placed.

FORMING THE SHOULDER BOX.

In the manufacture of the box, generally shallow, with a shoulder or neck, the box body may be made of a single blank as for the one-piece box, and the shoulder or neck of a narrow strip of board, generally lined with white enamelled paper, with three scored lines to make the four sides. Several of these necks may be cut at one time from one sheet of board, on a light rotary cutting machine, and then scored, or they may be cut and scored on the single or the double cutting and scoring machine.

The blanks are then ready for glueing and pressing, the first operation being done on a shoulder box glueing machine. This machine effects a great saving over the usual hand-glueing methods, and the quality of the product is greatly improved, since no surplus glue is applied. The machine is capable of turning out about 6,000 boxes daily. Provision is made for steam connection to keep the glue heated, but a gas burner can be used if desired.

After the box is glued it is ready to receive the neck to be pressed into position. The operator places the box

with the neck inserted into a duplex shoulder box pressing machine, which is built to handle two boxes, and the inverted glued box is placed on one of the formes. The presser block jaws then advance and press the four sides of the box uniformly, while the other set of jaws is opened to receive the next box. These jaws work alternately and the duration of pressure is sufficient to stick the shoulders of the box securely and to shape it perfectly square. The box body is then completed.

FORMING THE BOX LIDS.

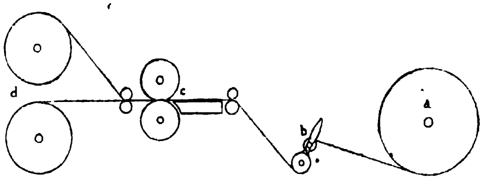
The lids of these or of the other kinds of boxes described are generally shallow, and can therefore be formed similarly to the method adopted for the one-piece box. Care should be taken that the adjustment of the cutting and scoring machine must include a slightly corresponding increase in length and width for the lid over those of the box body in the case of a one-pieced or end-pieced box, but not in the case of any box having a shoulder or neck. With most of the machines used in forming the box body or lid, formes or blocks are made to accommodate the dimensions of the box accurately.

If possible, it is also advisable to make first a model of the box required, as this will give more readily the details for the adjustments of the machine used, and, in the case of cutting and scoring machinery, further adjustment is necessary for different thicknesses of board. In the operation for forming the upright covered box just described, it should be noted that these have referred only to the methods essential when the boxes are to be covered by the series of machines mentioned in the following paragraphs.

When the boxes are to be "wrapped," certain of the operations are unnecessary, as will be shown later. For the present, the one-piece, end-pieced, and shoulder box methods dealt with show how each kind of upright covered box should be formed to make it ready for the covering operations.

Covering the Box.

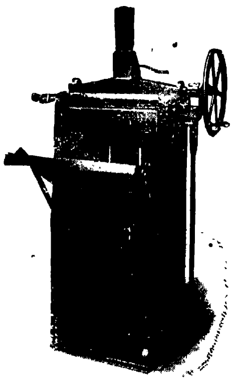
The box body and lid having been formed, the decoration of the box is the final stage. Printed, embossed and coated papers are adopted for this purpose. What are known as flint, or friction-glazed, and enamelled papers are used chiefly, though in latter years makers of surfaced papers have brought out some very artistic designs for box covering. For the manufacture of the upright covered box these papers are generally obtained in wide rolls, which are cut to the widths required on slitting and re-winding machines. These machines are fitted with upper and lower rotary slitting knives, between which the reeled paper is slit. It is then re-wound into coils on collapsible re-wind mandrels, which permit easy removal of the slit paper.



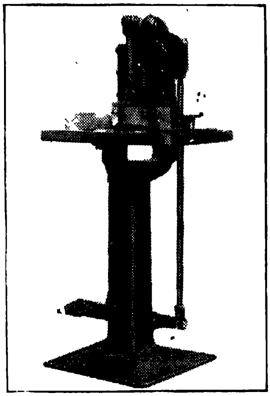
Slitting and Rewinding, showing, (*a*) the parent roll of paper; (*b*) the adjustable device for varying tension of paper as it unwinds from the parent roll; (*c*) the wedge clamp slitting knives; (*d*) the slit and rewound rolls.

One type of this machine has an adjustable mandrel for variation in winding of the parent roll, and an adjustable rod for varying the tension of the paper as it unwinds from that roll. In some machines the threading of the paper reduces the chance of breakage or wrinkling. An additional device that will be found useful is the counting mechanism for calculating the re-wound paper into reams for estimating purposes. These slitting and re-winding machines are supplied in all sizes and designs for handling the thinnest to the thickest of papers, and on some it is possible to slit only a part of the parent roll, the unslit part being re-wound on an upper mandrel.

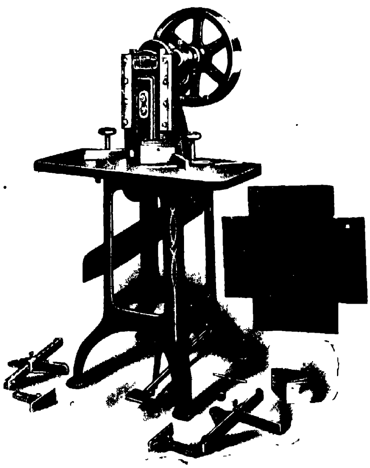
Types of Baling and Corner Cutting Machines.



Waste Baling Press.



Treadle Corner Cutting Machine.



$5\frac{1}{2}$-in. Power Single Corner Cutting Machine, showing Box Blank with Corners Cut out.

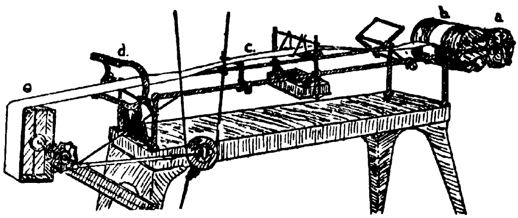
If the paper is required in sheets there are roll sheet cutting machines for both friction and gear drive, and with these machines box paper can be bought in the roll and cut into sheets to the required size as wanted. A double bracket affords accommodation for cutting two rolls of paper, and a canvas conveyor delivers the cut sheets. A remarkable machine is the combination roll sheet cutter, slitter and re-winder, which can slit the roll and cut it into strips from four inches long and one inch wide up to sixty inches long and the full width of the web. The rotary cross cutting knife is swivelled to compensate for the travel of the paper during the cutting interval, and this ensures a right-angle cut. The slit rolls are used on the covering and topping machines, and in many cases there are a large number of small rolls left which there is a tendency on the part of the operators to throw away. To use up these small rolls the waste roll re-winding machine can be employed to re-wind them into one good sized roll.

Banding or Stripping the Box.

In the decoration of the upright box body the first operation is the banding or stripping of the sides on a covering machine. The slit rolls of paper are slipped on to a spindle at one end of the machine, the paper being fed over a glueing roller, which is fitted in a glue pan holding the adhesive. The glue pan can be heated by gas, steam or electricity, or if a cold glue is used an upright tempering attachment can be added to the machine to give the necessary extra stretch of paper for tempering. After the paper leaves the glueing roller it is fed forward until it reaches the machine head, which comprises a cut-off, box forme spindle and drive. The box forme on the spindle is supplied to be adjustable to fit any size of box, and the cut-off can be operated by hand or automatically.

As well as applying a band to the sides of the box the same foot-power covering machine will simultaneously apply one or two edgings to the box if required. The strip (or strips) of covering paper, drawn through suitable ten-

ion devices, is placed on the box situated on the forme. The forme is revolved by hand and at the suitable moment he strip is severed by pressure on the foot treadle. While he box is being turned the band is rubbed down on sides nd bottom, and when removed from the forme the upper dges of the band are turned in by hand. The cut-off is asily adjustable to take up wear on the knives, and these pen wide to leave a convenient space for the operator o get hold of the strip. In well-known constructions of he radial adjustment box forme arm, the rubbing down urface of the box always remains at about the same eight, which is great convenience to the operator. Without leaving her seat the operator can transversely adjust he box forme in the event of the band not having been et in direct line with the box forme. About twenty ninutes should be allowed to the operator for changing forme and cover paper.



Box Banding or Stripping, showing (*a*) roll of covering paper; (*b*) glue pan and roller; (*c*) web of paper; (*d*) shear cut-off; (*e*) box body on an adjustable box forme.

When banding or stripping small boxes on the covering machine, obviously less paper is required per box than on large boxes and increased speed can be given to the machine as less time is required for tempering the paper. For this purpose a variable speed attachment can be obtained. Cigarette, jewellery, pill and powder boxes, and others which are small, can be banded on a power bench covering machine, on which plural strip devices can be furnished, so

that a reinforcing strip or an edging strip may be run at the same time as the finishing strip. For narrow stripping, when the machine can be run continuously, a special narrow, light-weight glue roll can be obtained. As the finishing strip or edge is glued to the sides so that a slight lap overhangs to be turned in on the interior of the box, the turning-in can be done, as described, by the operator on the covering machine, or by hand when the banded box is taken off the machine. There is also a turning-in machine on the market, but this is not generally used.

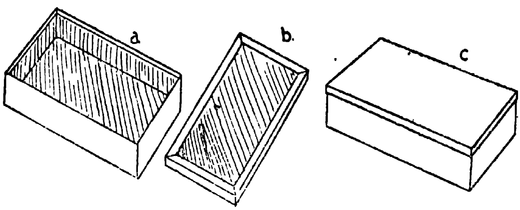
Another machine is obtainable which combines the functions of the staying and the covering machine for either boxes or lids. The staying device is connected with the adjustable box forme, and at each revolution of the forme the stay pieces are gummed, cut and attached to the covering strip. The stay paper is placed so that it falls upon the corner of the box accurately, and is rubbed down and turned in with the covering strip. Upright rods on this machine are graduated so that the setting of the roll is made exactly, and regulated so that the lap of the paper need not be more than an eighth of an inch. The work of the operator is similar to that in the running of the covering machine except that the strip of covering paper must always be started at the same point on the box. An indicator is provided on the forme to enable this to be done easily. The next operation in the covering of the upright covered box body is known as bottoming. A similar operation for the lid is known as topping.

BOTTOMING AND TOPPING.

Both the box body and lid can be banded on the covering machine, and then the top of the lid, and also the bottom of the box if required is ready for the topping machine. This machine is made in different designs, one of the best having its cut-off operated by electricity. The roll of paper after being fitted on the spindle is fed over a glueing roller and then passes over other rollers until it passes through the cut-off head. In the electrical power

topper a slight pressure on the table makes an electrical circuit which magnetizes an iron core in the solenoid and thus operates the cut-off. The table is pressed by the operator as she measures the paper along the rear edge of the box.

On the belt power topper the trip, working the cut-off, is actuated by the swivelled table holding the lid. This table is lowered by the operator the instant she starts to rub down the topping paper. Another machine is operated by treadle, the cut-off being of the double shear variety. The lower blade is set at an angle which reduces the surface the paper has to be drawn over, and together with the lift rod that raises the paper from the lower knife makes it easy for the operator to grip the paper without injury. As there is sometimes a danger during topping that the sides of the lid may be spread out or of the top caving in, an adjustable topping forme will be found an excellent support for the smoothing of the paper top.



The Upright Covered Box, showing (*a*) the box body banded; (*b*) the lid banded; (*c*) the lid topped and box completed.

Some box bodies require a paper leaf inserted, and for this purpose the topping machine can also be used. The equipment necessary is an auxiliary narrow glue pan and a narrow roller for glueing the edges of the fly leaf. The paper is taken from the roll and threaded similarly as for topping, the box is placed on its side on the table, and the paper is pulled forward the proper length and cut off, and then applied by hand along the inside edge of

the box. Other uses to which the topping machine can be placed are labelling, sealing, and special lining. A lace paper attachment for banding machines is also made which is simple and economical and combines two operations in one. Lace paper from the reel is employed and the procedure is much the same as that of double strip work on the ordinary covering machine.

LABELLING AND HINGE GUMMING.

When special labels, etc., have to be affixed to boxes, or small strips for hinged lids, the best way of coating them with adhesive is by means of the gumming machine. Many kinds of gumming machines are on the market, as these appliances are used for various purposes and are built to apply semi-liquid hot or cold adhesive, such as dextrine, paste, gum or glue, to paper, cloth, leather, or any flat, pliable sheet material. They will gum sheets of all shapes and sizes, from any width to the full width capacity of the machine. One machine can keep four to twenty workers in operation, and in many factories it is used for one-piece top covering and for gumming printed, embossed, lithographed or other special box tops, as well as for end labelling and wrapping.

A thinner and more even coating of adhesive is applied by this machine than is possible by hand, and it enables the hand worker to more than double her production, while an inexperienced worker can attend to the machine. As the gummed sheets pass from the machine they are delivered on the endless canvas belt by means of pick-off with the gummed side up. The movement of the belt can be controlled instantly by the operator without stopping the machine. A strainer in the glue pot keeps the adhesive free from particles of paper and dirt, and the flow of the gum to the roll is controllable so that a light or heavy coating can be obtained.

Labels can also be gummed on an automatic feed gumming machine, which takes one label from the pile, feeds it over the coating roll and delivers it, gummed side

down, into the operator's hand, ready for the box. One or two operators can work at a table facing the machine with the work to be labelled before them. Though the gumming roll runs constantly, the label feed mechanism is under clutch and treadle control. A pressure of the foot on the treadle feeds and delivers one label, and if the treadle is kept depressed the labels are delivered continuously.

Shoulder boxes, shells, partitions, the ends for the end-pieced box, which cannot be run economically on the ending machine owing to size or quantity, and all other work which requires marginal gumming, can be operated satisfactorily on the flange glueing machine. This machine will gum board or paper either on the edge or within three to four inches from the edge, and a delivery belt can be attached for conveying a quantity of gummed work to a number of operators. The flange glueing machine is driven by power and easily controlled and adjusted.

Automatically Made Upright Covered Boxes.

Machines have been placed upon the market from time to time which have attempted to complete automatically all the operations involved in the manufacture of the upright covered box, but so far with no pronounced success. Two machines, however, have met with some popularity among the large manufacturers of boxes to contain certain articles of domestic necessity. Both of these machines handle the board after it has been prepared as a box blank. In one kind a pile of blanks are placed on the hopper, from which the machine automatically removes one, bends over its four sides, applies a reinforcing or stay strip, covers the box with a trimming or bordering strip, cuts the paper the desired length for overlapping, turns over the covering strip on the box bottom and turns in that on the sides, after which it is shaped and ejected. This machine is built in three sizes, making boxes as small as 1 inch square and 3/16ths of an inch in depth and as large as 8 by 13 by 2½ inches.

The other machine has a somewhat wider scope, as it will make what is known as telescopic boxes (in which the lid is made to fit completely over the box body), as well as one-piece and two-piece boxes. This machine does not use stay or reinforcing paper, but cold water gum, of which a minimum quantity is required owing to a pressure in the machine of about 5,000 lbs. Various grades of blanks are handled, whether of strawboard, pulpboard or paperboard, varying in weight, and it will make any size of box from 1½ inches square up to that which can be made from a blank 17 by 21½ inches, providing the box is not more than 6 inches deep. In addition to the kinds of boxes described, this machine will also make double tapered boxes for nesting and collapsible boxes.

The operations described in the foregoing paragraphs have dealt with the manufacture of the upright covered box by means of various machines built specially for the different processes involved. Many of these machines, particularly in the covering operations, have been replaced for the making of high-class boxes required in large quantities by a distinct series of wrapping and associated machinery.

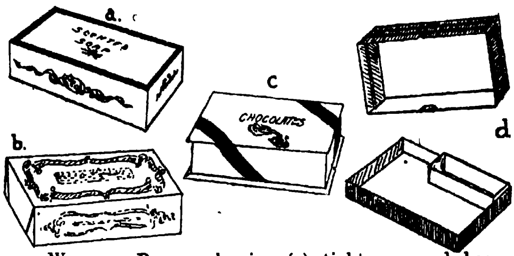
Wrapping the Upright Covered Box.

The wrapping machinery plant to which reference will now be made is somewhat in a class apart from the other machines described in this book, inasmuch as they are made by one firm and have little, if any, similarity to any other engineering firm's productions for that kind of work.

Generally speaking, the object of this plant is to produce a finished upright covered box after it has left the corner staying machine. In some cases however the box is produced complete without the necessity for corner staying. The plant aims at turning out a "wrapped" box in the most economical and artistic manner, and it has become so firmly established in the trade that "wrapping" a box is a phrase accepted as referring to the S. & S. processes, as distinct from "covering" a box which is performed

by the banding, topping, and similar machines described previously.

Three distinct kinds of work are turned out with the S. & S. plant, namely, tight wrapped, loose wrapped, and extension (or French) bottom. The various machines in this plant include a wrapping paper corner cutter, a corrugated roll gluer (for tight wrapped work), a wrapper, a stencil gluer (for loose wrapped work), an extension bottom gauge, a cardboard stencil gluer, a lacer and fly-leafer, a shoulder box gluer and a presser for this work, and a thumb-hole cutter. With these machines it is possible to produce any kind of upright wrapped box cheaper than by hand work though its equal or even its superior in appearance.

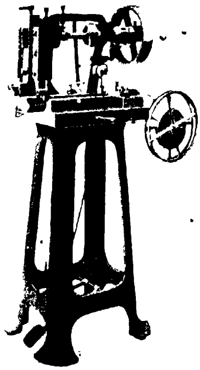


WRAPPED BOXES, showing (*a*) tight wrapped box; (*b*) loose wrapped box; (*c*) extension edge box; (*d*) shoulder box.

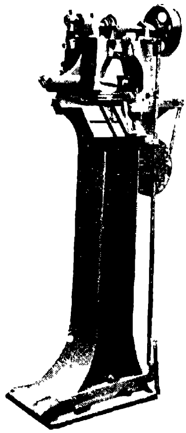
CUTTING THE WRAPPING PAPER.

The wrapping paper for boxes made on this plant requires to be corner cut so that it can be wrapped neatly and effectively round the box. Two kinds of boxes—tightly wrapped and extension bottom—have their wrapping paper prepared in this way. For tight wrapped work an acute-angled notch is cut, while for extension bottom work a wide angle cut is made. The S. & S. double corner cutting machine will do either work and is designed specially for cutting cover paper used on the wrapping machine. It will cut enough papers in one hour for a day's use.

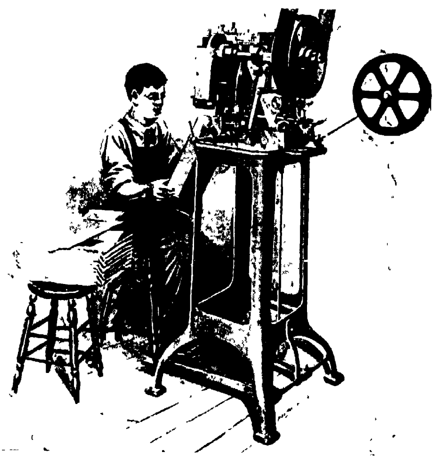
Types of Corner Staying Machines.



6-in. Corner Staying Machine for Power.

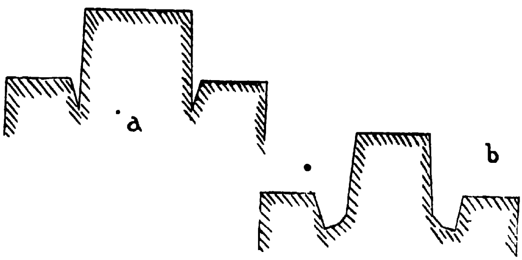


6-in. Corner Staying and Ending-on Machine.



Corner Stayer, with bent blanks ready for Staying.

This machine is equipped with open-point cutting knives. It was discovered that solid-point knives only punched out the notches and tore the paper, but with the open-point kind the cut is clean and uniform, while it will cut three times as many wrappers in one operation as the other kind. This corner cutter, Style "B," is of extra heavy construction, and is built with interchangeable sub-presses, which contain the knives and dies. By this means the machine may be changed in less than five minutes for another style of cutting without altering the set of knives. Adjustment is made quickly and easily by hand wheels and screws. Wrappers for boxes from 18/16ths of an inch to 18½ inches in width can be cut on this machine, with depth of cut according to requirements up to 4½ inches. The machine is operated by a treadle, and stops automatically after each cut.



Wrapping Paper Corner Cutting, showing (*a*) for tight wrapped work; (*b*) for extension bottom work.

Glueing the Wrappers.

When the wrapping papers are corner cut they are coated with adhesive preparatory to being affixed to the box. For this purpose the corrugated roll glueing machine is specially useful as it applies a thin uniform coating of glue under pressure. By this means it is possible to obtain great economy in glue and the elimination of moisture, which is the enemy of a good box. As very little glue is needed the wrapper is not moistened, and the beautiful

nish of glazed paper is retained, while fine printing or elicate tints are neither discoloured or destroyed.

The makers of this machine recommend hot glue being sed, because of its quick-drying quality and because it is etter suited to various grades of paper. Some manufac-ırers, however, have found cold glue quite successful on ›me classes of work. The machine is constructed for ;eam heating, though gas may be used if desired. In peration the small amount of moisture prevents any ten-ency to warp the board or to show its rougher fibre ırough the paper, and the method of handling the paper liminates the risk of finger marks or similar drawbacks.

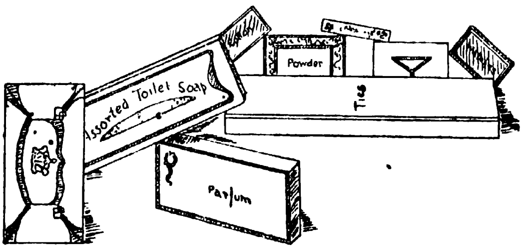
Two sizes of machines—one with an 18 inch and the ther with a 28 inch feeder roll—are obtainable, the former eing intended for use with the models "A" and "D" 'rappers, and the latter with the model "B" wrapper. ne glueing machine will accommodate two operators, ıpplying paper to two wrapping machines running on ight wrapped paper. A great advantage gained by the se of this machine is that the boxes are dry and straight nd ready for immediate handling as soon as they come rom the wrapping machine.

'HE WRAPPING OPERATION.

After the wrapping papers are cut and glued the rrapping machine does the rest. With this remarkable ıachine it is necessary for the operator to register the ardboard shell on the glued out wrapping paper and slip he shell on to the forme of the machine. The following rocesses are automatic and the finished box is ejected. 'o give an idea of its many uses, it will make tightly rrapped boxes with papers glued all over; loose wrapped ids with papers glued on inside only; extension ottom boxes or lids wrapped with one piece of paper; ightly wrapped and extension bottom boxes without corner taying; or padded and domed-top lids.

The S. & S. wrapping machine requires but few fixtures, which are inexpensive and easily adjusted, while its parts

are standardised and interchangeable. It can be reset for a different size box in about fifteen minutes, and it will apply a cover with five labels and trimmed edges at one operation. This machine requires but one operator and one glue-hand, who places the glued wrappers on an attached revolving table so that they are handy for the operator. Boxes or lids printed all over can be thus wrapped for the same cost as plain work.



TYPES OF WRAPPED BOXES, showing the wide range in style and size possible.

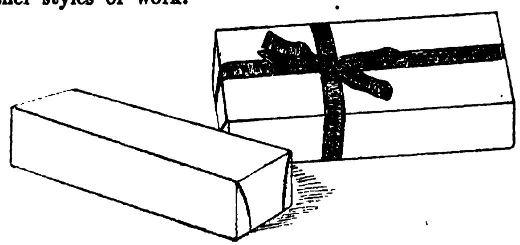
As the wrapping machine is used on so many styles and sizes of boxes, it is difficult to give any definite figures of production. Conditions of manufacture, such as quality of material, speed of the machine, and the efficiency of the operator, all enter into this question. Statistics have been obtained, however, from different plants operating these machines, and it has been estimated that one machine will have a daily output of from 5,000 to 9,000 boxes or lids. It has also been found that the best results have been obtained by the adoption of the piece-work basis of payment, the rate to vary according to the style of box and the wage standard.

The wrapping machine is built in three models covering ranges in size from 1⅝ inches by 13/16ths-inch by ¼-inch to 20¼ inches by 18½ inches by 4 inches. The model "A" has a range of adjustment for boxes measuring from 8¼ inches to 14¼ inches in length, 1⅜ inches to 8¼ inches in

width, and 5/16ths-inch to $2\frac{3}{4}$ inches in depth. The model "B" has a range for boxes from 5 inches to $20\frac{1}{2}$ inches in length, 2 inches to $18\frac{1}{2}$ inches in width, and 5/16ths-inch to 4 inches in depth. The model "D" has a range for boxes from $1\frac{5}{8}$ inches to 8 inches in length, 13/16ths-inch to 4 inches in width, and $\frac{1}{4}$-inch to $2\frac{1}{4}$ inches in depth. The average setting time allowance for a tight wrapped machine is about twenty minutes.

STENCIL GLUEING FOR LOOSE WRAPPED LIDS.

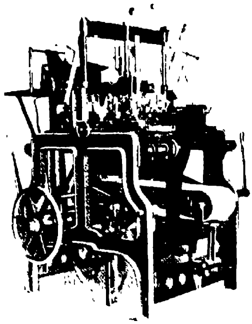
It has been found that a very decorative and effective method of wrapping lids, such as for confectionery and perfumery boxes, is by having them loose wrapped. The wrapping papers are stencilled with adhesive in a special way on the stencil glueing machine. By this process the margins of the papers are gummed only, so that the "turn-in" sticks quickly and firmly. As the stencil gluer is controlled by the wrapping machine operator it effects a great saving in labour, and at the same time it does not interfere with the operation of the wrapping machine on other styles of work.



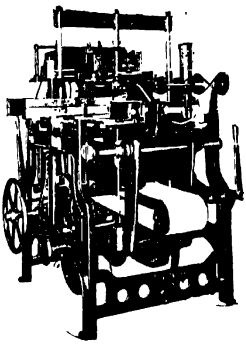
TYPES OF LOOSE WRAPPED BOXES, showing boxes produced by the "loose wrapping combination" of machines.

By the use of this machine in connection with the wrapper it has been computed that the cost of loose wrapped lids is about a quarter the cost of hand work, moreover much time is saved for the operator, as it has a capacity of 500 wrappers without replenishing. The

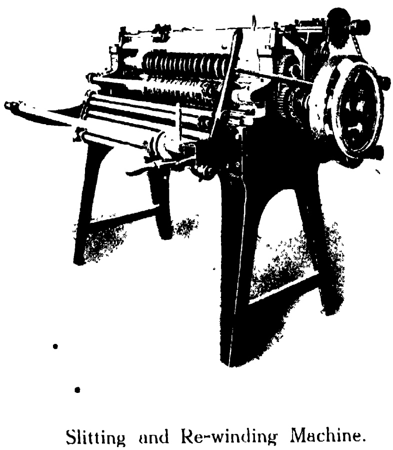
Types of Staying, End Setting and Slitting Machines.



Four Corner Staying Machine.



Double End Setting Machine.



Slitting and Re-winding Machine.

Specimen of a Cutter for Slitting.

stencils are adjustable for all sizes of paper between a length of from $6\frac{3}{4}$ inches to 18 inches, and the change from one size to another can be made in a few minutes. The adaptability of this machine has created the idea of working it in direct contact with a wrapping machine for loose wrapped lids.

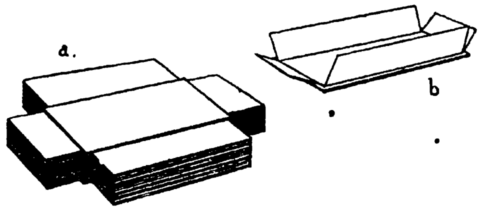
These two machines form what is known as the "loose wrapping" combination, and represent all the equipment necessary for this kind of work. Only one operator is required for this combination, as the stenciller is entirely automatic and controlled by the wrapping machine operator. The clutches in both machines are simultaneously released by the treadle, and the process is as follows: A wrapper is stencilled with glue stripped from the stencils and remains on top of the pile. The operator then feeds the stencilled wrapper and the lid blank to the machine for the covering operation.

EXTENSION EDGE WORK.

The extension edge or French bottom box, until the advent of the S. & S. plant, was a product of combined hand and banding machine labour, involving several handlings and altogether making the productive cost almost prohibitive when compared with that of the plain tight wrapped box. The extension edge (either top or bottom) box has, however, so attractive an appearance and is so distinct an advantage over the carton with the shallow or thumb-hole lid, that this class of work has become increasingly popular, and the S. & S. extension bottom covering attachment for the wrapping machine a most welcome event.

This attachment has been constructed so that it can permit of quick adjustment without in any way interfering with regular tight or loose wrapped work, or limiting the maximum range of the machine. Consequently, in busy seasons there are excellent opportunities for this attachment, since by replacing table workers, it meets the situation admirably and makes it possible to handle the work

rapidly and economically. The output, with two operators, will range from 8,500 pieces per day upwards, according to the speed and ability of the worker, and the various covering operations are performed in the same manner as for a plain tight wrapped box. The time required to place the attachment in position should not exceed five minutes, the facility and economy of this method being apparent to anyone familiar with this class of work.



EXTENSION BOTTOM WORK, showing (*a*) pile of box blanks with bottoms attached; and (*b*) extension edge box body ready for staying and wrapping.

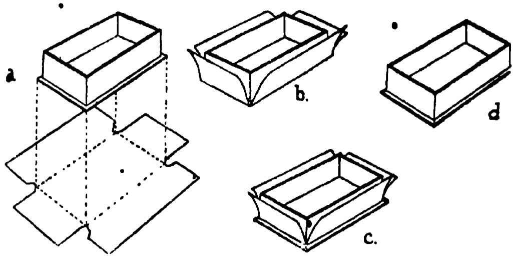
Extension edge boxes or lids may be covered by the attachment described without corner staying if desired. The complete equipment for this work includes the attachment for the wrapper, the special knives for the corner cutter, and the registering gauge for extension bottoms. The latter device is for attaching the extension bottom to the box body or lid. By means of the extension bottom gauge entire orders can be handled with despatch and economy.

Boxes can be corner stayed, after the extension bottoms have been attached, at the same cost as for plain work. If, however, the gauge is used without the S. & S. extension bottom covering attachment and the wrapper, and the boxes are to be covered on a banding machine the extension bottoms must be wrapped or trimmed before being attached to the box blanks. The extension bottom attachments are supplied for models " A," " B," and " D " wrappers, the range of adjustment being similar as for

ordinary work with the exception of the depth which, for the first two models of wrappers, is 2¾ inches maximum.

CARDBOARD STENCIL GLUEING.

The method of operation with the extension bottom gauge is to place the box blank on it, this blank being first pasted around the inside edges of the scoring line by means of a cardboard stencil gluer, referred to later. The extension bottom is then applied, being guided accurately on to the box blanks by the corner guides. If desired, the pasting operation may be reversed by first inserting the box blank and pasting the extension bottom before it is placed in the gauge. Box blanks and extension bottoms are then put in alternatively until the gauge is filled.



WRAPPING THE EXTENSION BOTTOM BOX, showing (a) the development of the wrapper; and (b), (c) and (d) the first, second, and third stages of the wrapping operations.

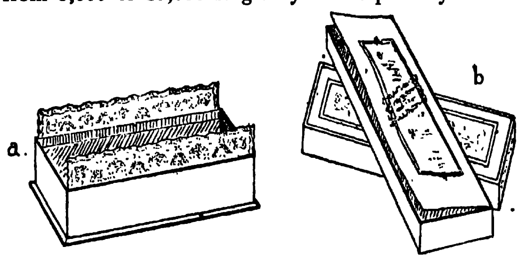
The whole pile is then withdrawn and put under pressure until the gauge is filled again, thus allowing sufficient time for the extension bottom to be thoroughly dried and to obtain proper adhesion. One operator with a hand stencil, can easily attach from 3,000 to 4,000 pieces per day, and the range of adjustment is sufficently large to handle any size of extension box up to 14 inches by 10 inches score measure. Recessed dies suitable for different depths of boxes are furnished for certain corner staying machines as required.

The cardboard stencil gluer, referred to above, was de-

signed for automatically stencilling box blanks for extension bottom work and for gumming the edges of fancy and picture tops, which are pasted for decorative purposes on the tops of finished boxes. One operator is required for this machine, which is controlled by a treadle and for extension bottom work automatically stencils one blank. This is lifted for the operator to transfer to the gauge, and while the extension bottom is being attached the machine is stencilling the next blank. A skilful operator can easily attach 16 to 20 extension bottoms per minute.

LACING AND FLY-LEAFING.

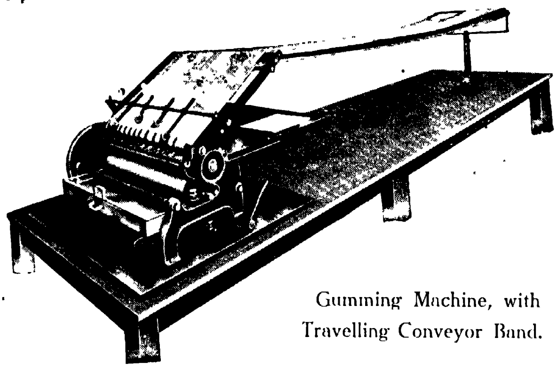
One of the great advantages of the lacing and fly-leafing machine, which is part of the S. & S. plant, is that it is valuable to the box manufacturer whose work varies in size and quality. An inexperienced girl can operate the machine with very little instruction, and the average output is from 5,000 to 7,000 double-laced boxes or from 8,000 to 10,000 single fly leaves per day.



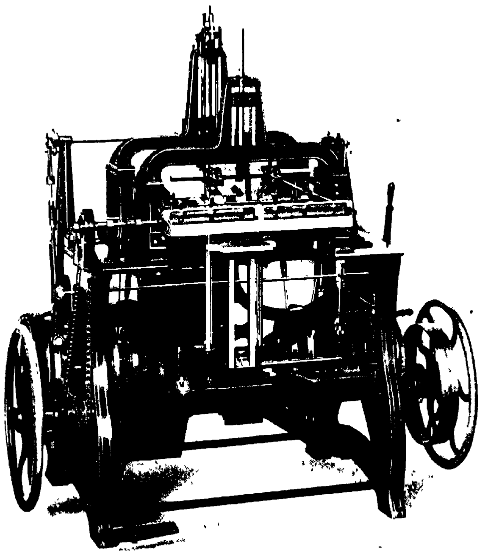
LACED AND FLY-LEAFED BOXES, showing (a) a double laced box; and (b) a single fly-leafed box.

This machine is built in two sizes—16 inch and 22 inch—and these dimensions represent the maximum length of laces or fly leaves that can be inserted. It is adjustable for laces from $1\frac{1}{4}$ inches to 3 inches wide and from $2\frac{1}{2}$ inches to 16 inches or 22 inches long, according to the size of the machine. Fly leaves up to 10 inches in width may be inserted, and the machine can be adjusted for a change

Types of Gumming and Box Making Machines.



Gumming Machine, with Travelling Conveyor Band.



Automatic Upright Covered Box Making Machine.

in size of box or lace in about three minutes, as there are only two parts to adjust.

Shoulder Glueing and Pressing.

A useful part of the S. & S. plant is that which deals with the glueing and pressing of shoulders or necks into boxes. The two machines for this process—the shoulder box gluer and the duplex shoulder box presser—were referred to previously*, and it is only necessary to add that the gluer will work on boxes from 2 inches square up to any reasonable size. If required for smaller work it may be altered to reduce the minimum limit to $1\frac{1}{4}$ inches square. The front plate is adjustable to accomodate the different depths of boxes.

With both machines worked to their capacity it should be possible to insert from 5,000 to 6,000 shoulders daily. The best results are obtained by using two fast operators, one to glue the boxes and the other to insert the shoulders and feed the work to the presser. The latter machine can handle boxes ranging from 2 to 9 inches in length and from 2 to 8 inches in width. Various kinds of shoulder box work can be turned out with the help of these machines very quickly and economically, and the manufacture of a box of this kind will be described later.

Thumb-holing.

The remaining machine of this plant is the portable thumb-hole cutter, which can be driven by power or by treadle. The depth of the cut is regulated by an independent gauge on each head adjusted by means of a thumb screw, and the heads may be set for work ranging from 1 to 14 inches in width. Cuts from $\frac{3}{4}$-inch to $1\frac{1}{2}$ inches in diameter can be made and of special shape if desired.

The motor-driven machine is geared to make 70 cuts per minute, and may be removed to any part of the factory, and it is better to take the thumb-holer to the work than to carry the work to the machine. A metal hopper collects the cuttings. Belt drive can also be arranged if necessary,

* See page 24.

but the manufacturer who has a limited quantity of this kind of work will find the foot power cutter equally serviceable.

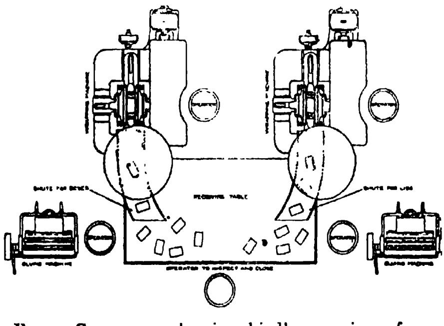
This completes the description of the different methods of manufacturing the upright covered box, but before the next kind of paper box is dealt with it will be advisable to describe the grouping of the S. & S. plant for efficiency and to give one or two examples in illustration of how a particular kind of box is actually made under conditions obtaining in the factory.

PLANT GROUPING FOR EFFICIENCY.

Before any attempt is made to describe the best way of arranging machinery for the production of a particular kind of box, or, as it is known, plant grouping, it will be advisable to describe the various S. & S. machines which serve to make a complete plant for the different processes involved. A single tight wrap plant comprises a wrapping, glueing, and a corner cutting machine. A single tight and loose wrap plant comprises a wrapping, glueing, stencil glueing and corner cutting machine. A double tight wrap plant comprises two wrapping, one glueing and one corner cutting machine. A double tight and loose wrap plant is similar to the latter except for the addition of one stencil glueing machine. The auxiliary equipment necessary for extension bottom boxes is the attachment for the wrapping machine the equipment for the corner cutting machine and the extension bottom gauge Model "W." For laced or fly-leafed boxes a lacing and fly-leafing machine, Model "P," is necessary, and for shoulder boxes a gluer, Model "T," and a duplex presser, Model "U," are essential.

The main object of careful machine grouping and working the operators in gangs is to increase output. In addition to adequate equipment, an equally large item of expense in box making is the cost of handling. The various methods of plant grouping which will be described in this section are based on practical experience, and it has been

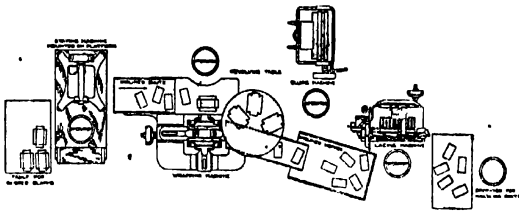
discovered that from twenty to fifty per cent. increase of output has been obtained on an average by the introduction of this system. The basic principle has been to prepare the material in successive stages and to eliminate all unnecessary handling. The first instance is that of a job involving the production of a tight wrapped box and lid. For this purpose one of the simplest forms of grouping is to arrange two wrapping and two glueing machines in sequence, or alternatively only one glueing machine need be employed, so that while one machine is covering the box the other is covering the lid, and then both are discharged over separate chutes to a table where a girl can inspect and stack finished boxes on trucks ready for the delivery room.



PLANT GROUPING, showing bird's-eye view of grouping of two wrapping and two glueing machines to produce tight wrapped box and lid.

The accompanying plan shows how this plant should be grouped, and it will be seen readily that in a factory where the box and lid are made on machines some distance apart or at different times a great deal of additional time and labour is required. In either case the boxes would be inspected and stacked in one place and the lids in another, and then both would be transported to a third point for the separate operation of closing, which would result in the work being handled unnecessarily about three times. It

throughout the factory. When the boxes are passed down the chute from the staying machine to the wrapper, the latter operator registers them to the glued wrappers or labels. The glueing machine operator takes the glued wrappers from her machine and places them upon a revolving table within convenient reach of the wrapping machine operator. The wrapped boxes are then discharged to the fly-leafing machine, from which the boxes are inspected and stacked.



PLANT GROUPING, showing plan of grouping a corner staying, a wrapping, a glueing, and a fly-leafing machine to produce a tight wrapped box with fly-leaf.

On this job the five operators, working nine hours a day, should produce between 7,800 and 8,000 pieces, which is approximately 866 pieces per hour. Estimating the labour charge for staying, wrapping and fly-leafing at an experienced worker's rate, and that of the two other operators—those for glueing and inspecting—at an experienced learner's rate, it is possible to arrive at a fair idea of the labour cost for the work involved. Only by a proper grouping of these machines is it possible to obtain such a low labour cost for this kind of work, and it will be found by this arrangement that not only is there a reduction in cost, but that the individual output of each machine is greatly increased, due to the systematic conveyance of the work to each operator.

PLANT GROUPING FOR SEVEN OPERATORS.

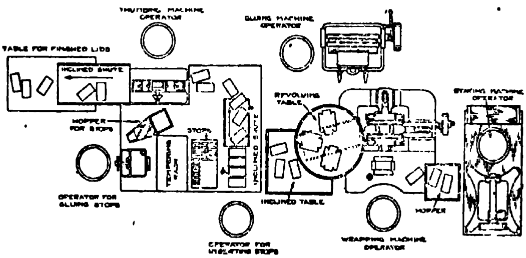
Similarly it is possible to secure an almost automatic effect by sequential machine arrangement for the produc-

tion of a perfumery box in which the lid is 5 ins. by $2\frac{1}{4}$ ins. by $1\frac{1}{2}$ ins., for a box body of $\frac{5}{8}$ in. in depth. The box referred to in this example is one in which stops are inserted in the lid as well as thumb-holes cut, and the operations involved are those of corner staying, glueing, wrapping, glueing and inserting stops, cutting the thumb-holes, inspecting, closing, and packing. For this work a gang of seven operators is required, and as with all these examples it is essential that the work as a whole should not be retarded by the inefficiency of any particular operator.

The corner staying machine in this group should also be elevated more than the remainder of the machines for the reasons stated in the preceding paragraphs. After corner staying the lids, these are thrown into a hopper at the left of the operator from which the wrapping machine girl takes them as fast as she can use them. The glueing machine operator places the glued wrappers on a revolving table in convenient reach of the wrapper, and after the lid is covered it is discharged down an inclined chute to the operator who inserts the stops. These stops, which are made so that the lid may fit no more than the shallow depth of the box body required, are glued and placed on a board in a rack near by, where they are allowed to temper. The operator who inserts the stops removes them from the rack and fits them into the lids, after which they are passed to the thumb-holing machine and thence to the operator who closes and packs the finished boxes.

By this method there is no unnecessary handling and a consequent reduction of cost plus an increase in output. The illustration of this plant grouping does not include a small machine which has been devised for inserting the stops into deeper lids. This machine glues, feeds and presses the cardboard stops in the lids automatically, the operator simply placing the work on the machine. The substitution of this machine for the hand-gluer eliminates one operator from the group, and due allowance should be made for this in calculating the labour cost for this kind

of box. The stop inserting machine will handle stops of either single or double thickness, straight or bent, at a rate of about 80 pieces per minute, depending upon the speed of the operator. Moreover, it is absolutely accurate, and prevents the spoilage of boxes which are caused by stops inserted which are half-glued or crooked.



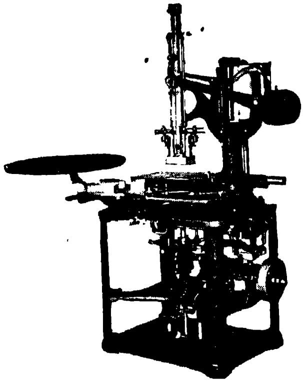
PLANT GROUPING, showing plan of grouping a corner staying, a wrapping, a glueing, a stop-inserting, and a thumb-hole cutting machine to produce a perfumery box.

Assuming that this machine is in use, and taking a concrete instance, it was found that by doing this work on a gang basis, the output over the ordinary method was increased by about 2,000 pieces per day, and that about fifty-five per cent. of the labour cost was saved. With regard to the charges for labour, these could be calculated as for seven operators who produce on an average 7,000 pieces in a nine-hour day, or 777 per hour. By the concentration of all these machines into a compact group, it is obvious that there is again no loss of motion and a great economy of floor space and power. The main principle to observe is that the product of each machine can be fed easily and quickly to the machine performing the next operation.

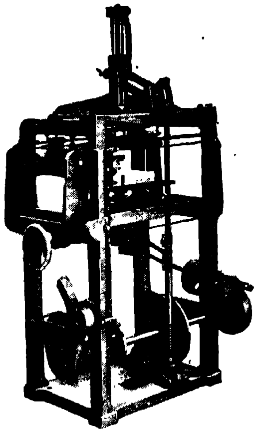
CONFECTIONERY BOX PLANT GROUPING.

Another useful example of the systematic arrangement of machinery to secure a maximum of production with

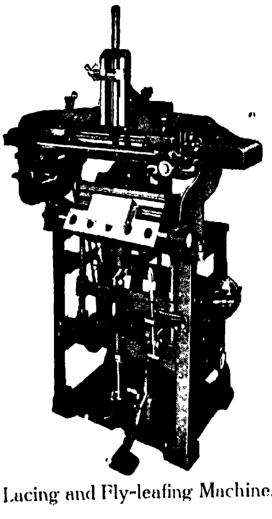
Types of Wrapping Plant Machines.



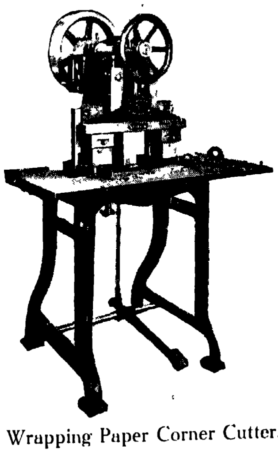
Wide Flange Wrapping Machine.



Stencil Glueing Machine.

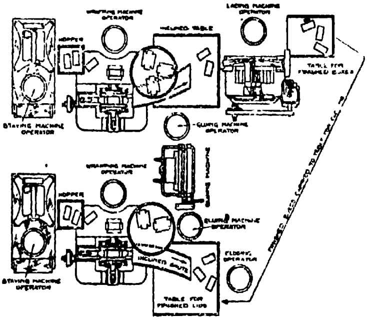


Lacing and Fly-leafing Machine.



Wrapping Paper Corner Cutter.

a minimum of cost, is afforded by the grouping of machines for the manufacture of an extension bottom laced confectionery box. In this grouping the box and the lid practically take a parallel course, each being corner stayed, and wrapped in the same manner as for a plain tight wrapped box. The first operation is that of preparing the extension bottoms, these being accurately registered and attached to the box and lid blanks by means of the extension bottom gauge, the blanks being glued with a hand stencil and placed alternately with the extension bottoms in the gauge. They are then delivered to the corner staying machine which, as before, is elevated on a portable platform.



PLANT GROUPING, showing plan of grouping corner staying, glueing, wrapping, and lacing machines to produce an extension edge laced confectionery box.

After the corner staying operation the boxes and lids are passed through a hopper to the wrapping machine operators, who have the glued wrappers placed within convenient reach. There the wrapping machine lids are discharged to a receiving table ready for closing. The boxes are discharged to a hopper in convenient reach of the lacing machine operator, who applies the two laces and passes them on to the receiving table. This completes the manu-

facture of the boxes, which are carried a short distance by, say, a mechanical conveyor, to the table on which the lids have already been discharged, and there the work is closed ready for packing.

This job requires six machines and eight operators to turn out in a nine-hour day an average of 5,500 complete boxes and lids, or about 611 boxes per hour. From this information it will be possible for box manufacturers to ascertain the actual labour cost involved at the rates of wages ruling in their particular district.

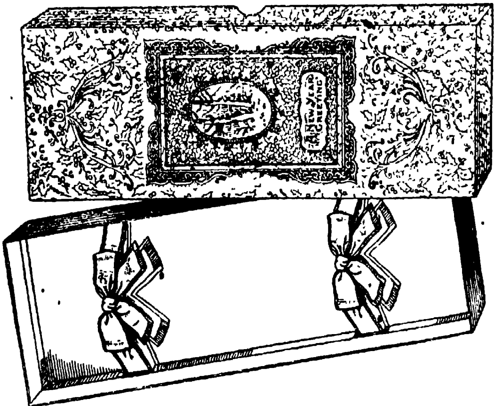
Six Machine Plant Grouping.

The two concluding examples will be for work of a different nature, the first of which will refer to a necktie box about 13 ins. in length, 4½ ins. in width, and ¾ in. in depth. The slip-on lid can be decorated with an attractively embossed cover paper, the centre of which is cut out to allow for the insertion of a postcard greeting design over the edges of which a cover paper is fixed. The bottom of the box has two original cut-out patterns to resemble folded bows, which are fixed by the outside lining paper so that the neckties can be held in their place neatly. Boxes similar to this have been produced at the rate of about 6,000 per day of eight hours.

The plant actually employed for the output comprised two corner staying machines, two S. & S. Model "A" automatic wrapping machines, and two S. & S. Model "R" 18 inch glueing machines.

The work performed consisted of corner staying the boxes and lids, glueing-out the covering papers, affixing the postcard design with the cut-out space in the lid wrappers, completely wrapping the boxes and lids, and lidding-up and packing. An essential feature in obtaining the maximum output from the machines used was to group them correctly, so that the sequence of manufacturing operations took place in proper order, and lifting, stacking, or all unnecessary handling of work was eliminated. This correct grouping applies to practically every machine in the

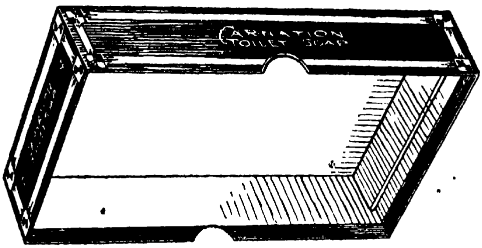
paper box factory, but more particularly to the series of machines now being described.



NECKTIE Box, showing slip-on lid, with postcard greeting design inserted in embossed cover and box body with two cut-out patterns to resemble folded bows.

A better idea of this grouping will be obtained by describing the methods of manufacture in conjunction with the illustration on page 54. The arrangement of the six machines mentioned gives the maximum output with eight workers only, one set of machines being used for the boxes and the other for the lids. Taking the lid portion of the box first, a pile of previously corner cut strawboard blanks is placed at the left-hand side of the corner staying machine operator, marked A, who stays up the four corners of the lid, and drops the shell thus formed to the right-hand side of the wrapping machine operator, marked B. The glueing machine operator, marked C, glues out the lid-covering papers on the Model R 18 inch glueing machine. As each sheet is glued-out, she places it on the revolving table of the wrapping machine, where, in turn, the operator D applies the postcard into the outcut space of the covering paper.

deeper than the bottom or tray, and stops are inserted within each end of the lid. These stops rest on each end of the tray, maintaining the lid and tray in their proper positions when the box is closed. The group of machines and operators engaged in covering or wrapping these boxes, and fitting them up, produced 8,000 in a day of eight hours.



TOILET BOX LID, showing two small stops inserted (see inside right wall to fit the box body).

An examination of the finished article shows that the box is a specimen of excellent work. Furthermore, by the grouping of the machinery, as described and illustrated, see page 57, each operation takes place in its proper sequence, and no carrying of partially finished work is entailed. It is due to this continuous movement towards completion that the vast output of 8,000 boxes and lids, completely covered, with partition and stops inserted, and lidded up, is attained in eight hours with only ten operators. Even this small number of workers may be further reduced to eight if the shaping machines are omitted.

It is a demonstration of a fact, frequently overlooked in a box factory, that every time a box is lifted or carried its cost has been increased. As has been explained, the object of the grouping of the machines for the production of the box now under review is similar in this respect to that of the grouping of the plants already described. It must also be understood that similar boxes are required for a variety of other purposes, and in all such cases a similar

grouping of automatic machines can be usefully and economically employed.

The boxes and lids have been previously fixed at the corners on an automatic four-corner staying machine, and the small box forming the partition will have been previously covered on an automatic wrapping machine. The shells are then brought to the wrapping machines, which are served by two operators, marked A, for whom covering papers are being glued-out on one glueing machine, situated between the two wrapping machines by the two operators, marked B. As the covered boxes and lids are automatically ejected from the two wrapping machines, they fall within easy reach of the operators, marked C, who drop them into shaping machines. A shaping machine serves to

TOILET BOX PLANT GROUPING, showing ten operators producing 8,000 Colgate's "Combined Comforts" boxes in a day of eight hours.

square up the four sides of boxes or lids, but its use is entirely optional, and it is, in fact, rarely employed except on the very best class of work.

After leaving the shaping machine, the tray of the box is pushed forward to the operator, marked F, who

glues the bottom surface of the partition box by placing it on a board previously spread with glue; the adhesive so applied being ample to fix the partition box securely to the tray. From the operator F, the box, now fitted with the small partition, is allowed to slide to operator G, who is employed in the process known as "lidding-up."

In the meantime, the lid is passed from the left-hand side of the shaping machine operator to the operator D, who places each lid as it comes to her on the thumb-holing machine. The lid is then passed to the operator E, who serves the stop inserting machine, which automatically inserts the two small stops into the lid. This lid is then pushed along to operator G, who closes and bundles the finished boxes.

With the description just completed, it is believed that there has been chosen sufficient examples of plant grouping to indicate to the practical man in which way he can secure the best output at the least cost when installing new plant. The examples may also serve the purpose of suggesting something to the owner of a plant already in commission. In either case it is well to remember that some allowance must be made for the slightly varying conditions which exist in different factories.

This now completes the various processes for the manufacture of the upright covered box, such as is rigid and held together by means of adhesives only. The next kind of box to be dealt with will be the folding box, or carton, which can be stored in a flat condition when empty and for which there is now so extensive a demand as a container for all manner of domestic goods.

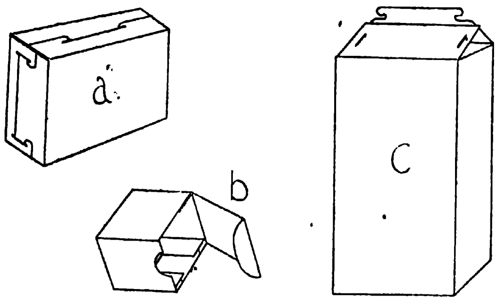
§ 4

THE FOLDING BOX, OR CARTON.

IN the various descriptions of angular cardboard boxes with which this book deals, except the folding box, that is to say with the upright covered, the upright wire stitched, and the collapsible wire stitched and taped types, one necessity is common to all, namely, a material for fastening the box, such as corner staying paper for the former or sealing tape and stitching wire for the two latter. For the carton or folding box no such fastening material is required. After the blank is prepared, it is either ready for use immediately by being bent along grooved lines until the box is formed by interlocking, or one side of the blank has a narrow flange which is glued to the opposite side to form the box leaving the adjoining flaps for closure.

It will be obvious, therefore, for such a box that the material used must be thin, pliable, and yet strong. A special kind of board, known as folding boxboard, is made for this purpose, and it is supplied either in natural tint or coated in white, or in various definite shades, according to whether it is required for plain or printed cartons. This thin, resilient board is, in consequence, also suitable for embellishment by an embossing process, and some very artistic styles of decoration have thus been obtained. The growing commercial popularity of the carton has been due to this fact, as well as to its flat condition when not in use and to the simplification of the manufacturing operations involved, when compared with those for other kinds of boxes.

The vast majority of cartons are made from one piece of board. The exceptions are of the slide or skillet variety, made from two strips, and for such cartons as are formed from two or more cut strips which interlock. For every variety, however, the principle of construction is similar, the board being so cut, creased and printed that it can be assembled easily. Whereas the blanks for the upright covered and wire stitched boxes must keep within rectangular shape, those for the carton are made in all manner of outlines, and there apparently is no end to the diversity of shapes from which a carton can be formed.

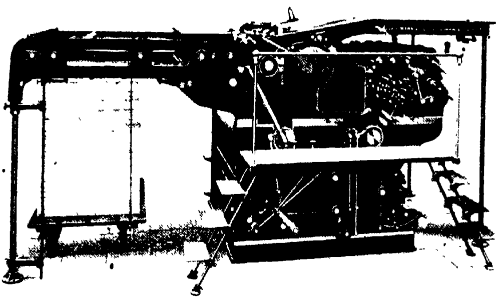


Types of Cartons, showing (*a*) an interlocking confectionery box; (*b*) a glued incandescent gas mantle box; and (*c*) a glued food carton.

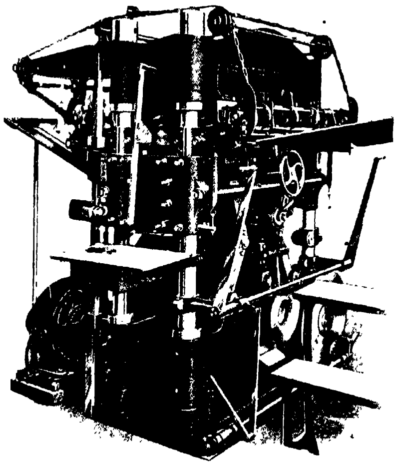
The Method of Manufacture.

There are three distinct methods of making the carton. The first, and most general, is by means of the cutting and creasing platen press; the second is by means of the cylinder cutting and creasing press; and the third is by means of the rotary multi-colour printing, cutting, and creasing machine. The two former operate on a single sheet of board, superseding the folding box punching machine which was used widely some years ago; the latter operating on the board from the roll. In each case, if the carton blank requires glueing, it is then

Types of Carton Printing and Embossing Machines.

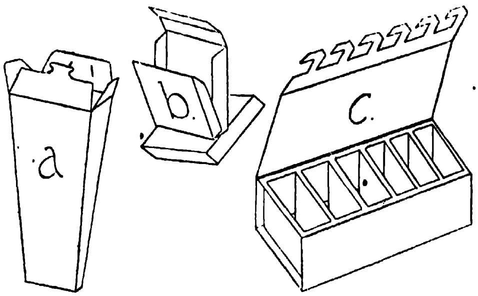


Two-Colour Offset Press for Printing on Carton Board.



Continuous Feed Carton Embossing Press.

passed through a folding box glueing machine. When the blank is prepared on either the platen or the rotary cutting and creasing press, the sheet must first be printed or otherwise decorated. On the rotary multi-colour printing machine all the cutting, creasing and printing operations are performed during the run of the board through the machine.



TYPES OF CARTONS, showing (*a*) a tapered confectionery box; (*b*) a two-strip or slide cigarette box; and (*c*) an egg carton.

With regard to the first two of the methods mentioned, platen and rotary presses are also made with inking attachments for preparing the blank complete in one operation; but it has been found preferable by some firms to separate the printing and embossing operations from that of the cutting and creasing if a high-class decoration is required. Folding boxboard may not always have a smooth printing surface, and to obtain striking and clear effects it has been found abvisable to use a rubber offset impression for printing. As the cutting and creasing must be done with steel rule, and the offset printing requires a rubber impression cylinder, it will be understood that the one press would not do both kinds of work.

Various kinds of printing machines can be used for the decoration of the sheet intended for the carton. For small

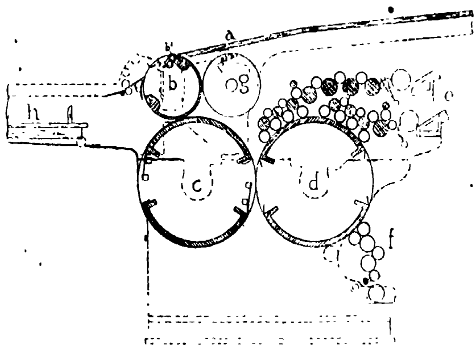
sheets a platen press, similar to that used for cutting and creasing, has been found sufficient, but where large sheets are used with a number of cartons to be worked on each sheet, it has been found advisable to use either a rotary lithographic or offset press, which runs at a high speed and yet produces very high-class printing. The main points to be considered in the choice of such a machine are: (a) good ink distribution, so that extreme solids can be printed without any clogging of ink on the ink plates; (b) accurate register for two and three colour work; and (c) the control and delivery of the printed sheets to ensure a high output.

Printing the Carton Board.

If the sheet from which the cartons are to be made is to be printed, care must first be taken that the designs are registered exactly to fit the size and shape of each carton. A sheet of board of, say, 20 by 30 inches, may produce from two, if large, to twenty, if small, cartons. Assuming the size of the carton permits ten to be obtained from each sheet, the printing surface must be set so that it can make ten separate impressions of the design on the sheet, with due marginal space for the cutting and creasing operation. This is done by or with the help of the operator who is responsible for setting the cutting and creasing forme.

Once the register is accurately obtained, the design is repeated by means of transfers as many times as there are cartons to be made from the sheet. Printing plates of metal, varying in style according to the press used, for two-colour rotary offset presses are flat when transferred upon, but are bent round the cylinder for printing. The offset printing principle is that the ink is distributed over the metal plate and then transferred to the rubber surface of the blanket cylinder, from which the design is impressed upon the sheet carried on a third cylinder and known as the impression cylinder. The metal plate, transferred with the design for the cartons, is fixed to a plate cylinder, and as the offset process requires the use of inks which contain

the maximum amount of colouring matter, an effective ink distribution is essential for fine work in tints, and for solids.



Offset Printing, with front delivery, showing sectional views of (*a*) feed board; (*b*) impression cylinder; (b^1) gripper; (*c*) blanket cylinder; (*d*) plate cylinder; (*e*) ink ducts; (*f*) damping rollers; (*g*) transfer cylinder; (g^1) gripper; and (*h*) delivery table.

To obtain this necessary distribution of ink, some presses are equipped with four and some with six rollers. In the offset press, there is an impression cylinder to take the sheet similarly as with the ordinary rotary press. The best kind of machines give easy access to both the plate and blanket cylinders, and permit of the feeding of the sheets to the top of the impression cylinder. For practically the majority of carton designs, two-colour work will be found ample. Where work is required in four, six, eight or more printings, it is simply a matter of changing the plates and colours, and then passing the sheets through the machine to receive a further two-colour impression. The same machine can also be used for perfecting, *i.e.*, printing back and front of the sheet each time it passes through the machine.

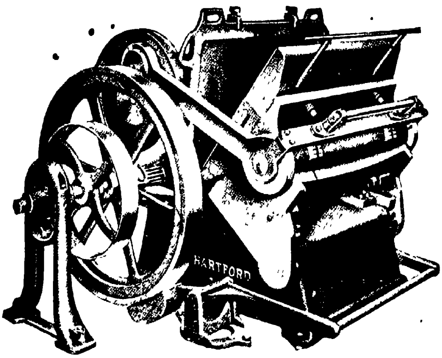
A new system for setting printing plates on platen and flat bed machines, known as the upright grain printing base system, has been brought on the market, the base, as its name implies, being of end-grain wood. The wood, which is maple, is treated scientifically so that atmospheric conditions have practically no effect upon it, and the grain is endwise between the bed of the press and the printing plate. The forme is made up by tacking the plates with one tack in each diagonal corner, which holds them sufficiently to obtain true register, and then other tacks are added and set. The end-grain surface grips the plate, and makes it unyielding to impression and prevents it dragging against the tacks or jumping up.

When the sheet is printed and requires embossing, there is a machine for this purpose made in four sizes, ranging from 64 by 44 inches to 36 by 26 inches. The output is 16 to 24 embossed sheets per minute and perfect register is guaranteed by means of an accurate device locking the gripper bars to which the sheet is fed. A pressure of 500 tons on each impression is obtainable on the full surface, bringing out the smallest details.

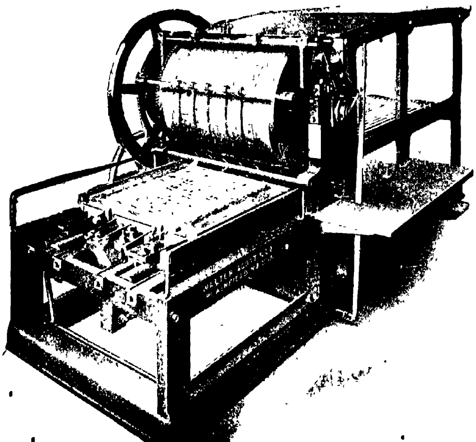
Cutting and Creasing.

When the sheet of board is ready to be cut and creased into cartons, and either the platen or cylinder cutting and creasing press is used for this operation, the first thing which has to be done is to prepare or "make-up" the forme. This forme is held in a chase, and has locked in it the steel cutting and creasing rules, the edges of which make the carton blank. Steel rule for this purpose is obtainable in three varieties: (1) a soft steel cutting rule, with a knife edge, for bending into various shapes; (2) hard steel cutting rule, also with a knife edge; and (3) steel creasing rule, rounded slightly on one edge, for creasing the board where the fold should come. This rule is sold by the foot, that for creasing being .918 inches high, and that for cutting .928 inches high. It is obtainable from 2-point (.029 inch) to 6-point (.088 inch) in thickness.

Types of Cutting and Creasing Presses.

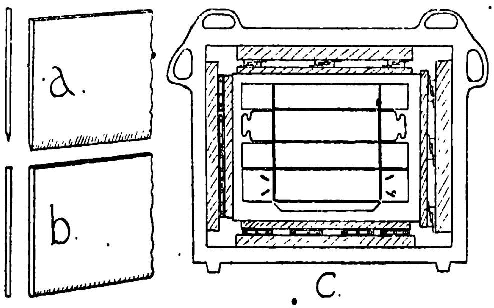


Cutting and Creasing Press for Carton Blanks.



Direct Drive Cylinder Cutting and Creasing Press.

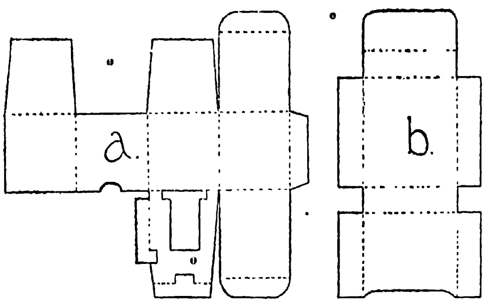
Before the cutting and creasing rules are prepared for locking into the forme, it is advisable to design a dummy or model of the carton, and preferably out of the boxboard to be used. The model of the carton blank is pencilled on the board, and then cut out to shape with a sharp knife or scissors. It is then folded to ascertain if the shape is correct, and the building up of the steel rules is based upon it. The chase, which holds the forme, is placed on the imposing stone or on the flat smooth surface of a work table. Each piece of rule is cut or bent to exact size on



CUTTING AND CREASING, showing (*a*) side and front views of steel cutting rule; (*b*) side and front views of steel creasing rule; and (*c*) a chase with a forme of cutting and creasing rules locked in (the thick lines representing the creasing and the thin the cutting rules).

a rule bending machine, and then placed in position in the chase, being held upright by means of small metal furniture set on either side of the rule. When all the pieces of rule are in position, the small pieces of metal furniture may be replaced by larger pieces of black cherry wood furniture. This wood is set close to the rule, as later on corks will be glued to it to push the sheet away from the forme when it is being cut and creased on the press. Some firms, to preserve more accurate register, use metal furniture throughout, glueing the corks to it with silicate of soda or some other powerful adhesive.

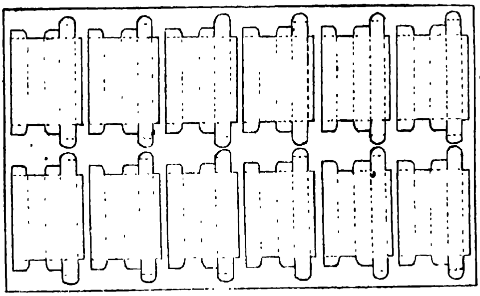
The centre of the forme is then blanked out with steel notched or metal furniture, and all smaller places not occupied by wood should be filled in with metal. Large pieces of wood furniture are then placed on the four outer sides of the forme leaving space for the locking quoins at the top and right hand sides. Strips of thin wood should be inserted between each set of quoins and the chase to prevent the former loosening. The forme is then planed down to see that no rules are higher than the others, and the quoins locked. Before it is placed in the press, the forme should be carefully examined, and this can be done by elevating one end of it on a small block of wood.



Cutting and Creasing, showing (a) a design for an incandescent gas mantle box blank; and (b) a design for a cigarette carton blank (the straight lines showing where the board blank is cut, and the dotted where it is creased).

Among the faults which should be guarded against are looseness of the rules judged by pressing lightly with the fingers, and this can be remedied by the insertion of small pieces of paper; incorrect angles of the rules, which can be judged with a T square and remedied by adjusting the locking of the furniture; the unequal length of parallel rules, which can be noticed by a slight bend in the longer rule and remedied by filing off a portion. Little openings should be left at the corners where the rules join so that

the pieces of board will not fall apart into the press while the sheets are being cut and creased. When steel cutting rule loses its sharp edge it can be converted into creasing rule by reversing the operating edge. Two or three pieces of the worn rule may be put together to form a wide creasing rule when needed for heavy folding box work, but for the average carton 2-point rule will be found sufficient.



CUTTING AND CREASING, showing a design for twelve tooth paste cartons in one forme, the dotted lines representing the creasing, and the straight lines the cutting.

For certain kinds of simple or odd-shaped designs the forme is prepared in a somewhat different manner. After a model of the design has been cut out of board or paper, this pattern is traced with a pencil on a block of laminated wood, which is slightly less in thickness than the height of steel rule. The pattern is then cut out with a fret or jig saw, and the steel cutting and creasing rule is shaped round it. The cut-out wood pattern with the rule are then fitted into the block from which the pattern was made, and the forme is complete. Such formes can be stored away entire for future use, without involving the locking up of much valuable furniture.

When the forme is completed, an impression should be pulled on a sheet of the board to be cut and creased.

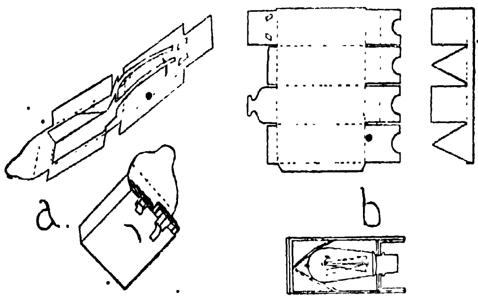
The sheet will probably cling to the steel rules of the forme, and to prevent this, corks should be glued at intervals to the wood or metal furniture along each side of the cutting rules. These corks should be about 3/16ths of an inch in height, so that they will not hold the platen away from the forme. No corks are required for the creasing rules, and for extra heavy work cubes or strips of thick rubber will be found suitable. When the forme is corked rightly another impression is then made, and the sheet thus cut and creased is held to the bare platen plate. The platen of this press should be of hardened steel, as brass platens become marked more quickly with lines from the rules.

Preparing Formes for the Press.

The second impression of the cutting and creasing rules is used for adjusting both the forme and the press to do accurate work, and this operation is known as "making ready." It is a good plan when commencing to make ready to lower the impression slides several notches (by loosening the nuts holding the slides), so that the impression will be somewhat weak. The slides should then be moved up gradually as necessary and an impression made on a sheet after each adjustment until the cutting rules cut through cleanly and sharply. The four corners of the sheet can be tested for this, and if there are any weak cuts the steel rule can be improved by fastening pieces of paper on the back of that part of the forme or under the steel platen plate. This forces all the rules to cut uniformly.

To assist in the creasing of the board, a fresh sheet should be taken and one side covered entirely with a coating of fish glue. This sheet should then be fixed to the steel platen plate in exact position to the feeding guides, and rubbed down with a soft cloth until the surface is quite smooth. Then the surface of the rules should be inked with a hand printing ink roller, and a clear impression of the rules imprinted on the glued sheet. All the lines made by the creasing rules should then be cut out accurately with a sharp "make-ready" knife so that channels are

formed into which the creasing rules can press the board during the run. The channels or crevices should be slightly wider than the rules to allow for the thickness of the board in bending. This sheet is known as the counter or female die, and is an important part of the "make ready." Unless it is prepared carefully the creasing of the work will not prove successful. The preparation of the counter die, after the imprint is taken, should be done while the forme is being corked, to save time.



TYPES OF CARTONS requiring two or more strips to complete the box, showing (a) blank and carton for cigarettes, and (b) blank and carton for electric lamps

THE PRESS IN OPERATION.

The impression of the press should be regulated before a run is commenced, as an excessive impression will soon cause the cutting rules to lose their sharp edge, while a weak impression will not permit the waste to be broken away easily. If the slides holding the throw-off bar are lowered before making ready, and then moved up gradually until there is just enough impression to cut the board neatly, these troubles will be prevented. Then the feeding guides should be glued into correct position on to the platen plate. Small pieces of thin brass rule bent at the top with a lip or projecting head make excellent fenders to prevent the board from going over the guides in the feeding.

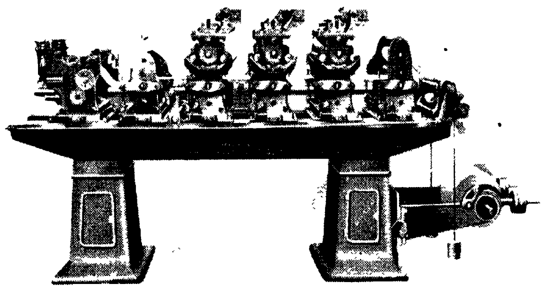
Though the speed of a cutting and creasing press depends mainly upon the ability of the operator, it should be possible to obtain 1,500 impressions per hour. If the board to be worked is placed near the press, this will assist in rapid feeding. The board should be kept as flat as possible, as curled sheets may cause faulty impressions. It would be helpful to bend down the sheets slightly at each corner. If there is a feed board to the press it should not be piled too high with the sheets as it makes the work of feeding more difficult. Occasionally, during the run of a job, certain places in the steel cutting rule may have a tendency to wear down. To re-sharpen these edges a small piece of folded emery cloth should be rubbed along the face of the rule. If the rule is much worn after, say, a long run, the emery cloth should be dampened with a few drops of machine oil and the impression strengthened by fixing one or two sheets of paper on the back of the forme or under the platen where the wear has taken place.

When the forme is put on the press for a run there should be some adjustment for holding the former rigidly in register. On some makes there are two set screws for this purpose. Care should be taken that the chase clamps are also screwed down tightly, as any negligence of this may result in serious damage to the machine. As the platen guard on most presses is automatic and recedes by gravity, the slots should be kept well oiled. When the press is required to do printing and embossing work, sets of ink ducts and rollers are required for the printing work, and male and female dies for the embossing.

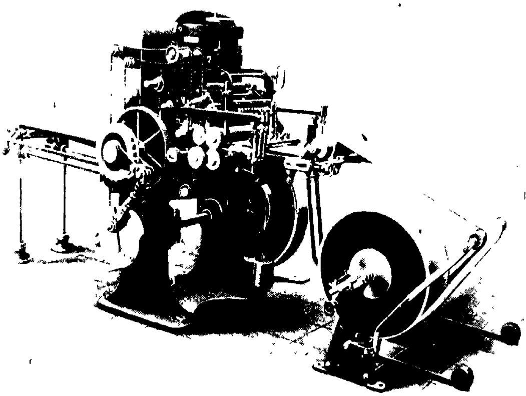
The Cylinder Cutting and Creasing Press.

Practically all the methods adopted in preparing formes for the platen cutting and creasing press apply to the cylinder press, the main difference between the two presses being in their manner of working. The cylinder press is constructed on the principle of a flat bed printing machine, the sheets of board being drawn round the drum to be cut and creased. The chief advantage of this machine is its

Types of Carton Printing, Cutting and Creasing Machines.

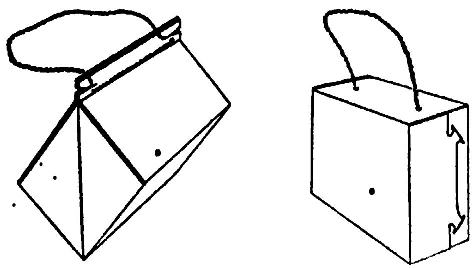


Rotary Multi-Colour Printing, Cutting and Creasing Machine.



Reel Printing and Punching Machine for Cartons.

high output, it being possible to obtain 2,500 impressions per hour. To assist in securing this high speed the bed of one kind of these machines is driven by a direct drive centre bed motion, such as is now used on all modern two-revolution printing presses. This method eliminates vibration.

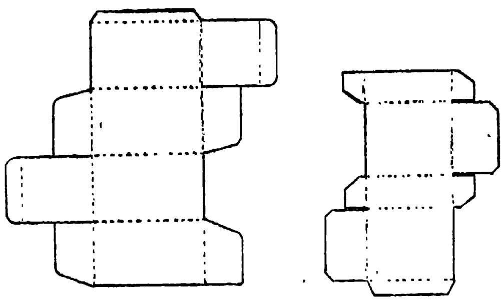


TYPES OF CARTONS, of the carrier variety, made out of one piece of board, suitable for confectionery.

One very substantially constructed press has four wide-faced steel shod tracks upon which the forme runs, and there are two connecting air chambers at each end of the machine. These enable the lightest or heaviest cartons to be worked without faulty impression and with true register. On one size of this press the bed is 34 by 44 inches, and takes a standard forme of 30 by 40 inches. The bed of the larger size is 48 by 69 inches, and takes a forme of 44 by 64 inches. In both cases the bed is easy of access, so that the forme can be rectified quickly wherever the rules show signs of wear. It is advisable to remember when making up the forme that rules previously used should never be set with new rules.

Although steel rule may be in good condition after a run, and therefore worth saving, a good forme should only consist of rules that are slightly worn or of new rules entirely. Formes which may be required again should,

if in fair condition, be stored in a cabinet with sliding shelves. To store them the chase should be placed on a shelf and then the forme unlocked to remove the chase. A piece of cord tied round the forme will keep it intact; but if extra chases are available it is better to keep the forme locked in the chase in which it has been used. If a forme rises up in the centre, heavy strips of paper about $\frac{1}{4}$-inch in height should be inserted between the furniture near the sides of the chase.



TYPES OF CARTONS, showing varieties produced on a cylinder printing, cutting and creasing press, in one operation.

There is also on the market a two-colour printing, cutting, and creasing press, similar to the cylinder cutting and creasing press. This press enables high-grade printing to be done, because a separate cylinder is used for the printing to that used for cutting and creasing. The time allowance for setting the large cylinder press should be about two-and-a-half hours, while for a cylinder cutting and creasing press about twice as long.

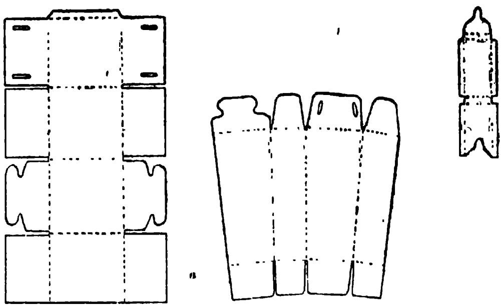
ROTARY PRINTING, CUTTING AND CREASING.

If it be desired to make a carton in large quantities of any one particular shape and style, such as may be used

for some well-known food or other preparation, providing it is not more than 12 inches in width, it may be produced to advantage on the rotary multi-colour printing machine. Manufacturers of such proprietary articles, which are packed in cartons, will find this machine useful, not only for making folding boxes, but also for labels and wrappers. It is capable of extension to provide for additional inking attachments, and as many as eight printers can be affixed to execute from one- to eight-colour work. This rotary machine has a reel feed, taking the cardboard or paper from the roll, and a tension apparatus for regulating the web. All the operations are performed on the rotary principle, the web of board or paper being drawn tightly over series of rollers for the various processes involved. The first is that of printing, each colour being printed in sequence by its own set of ink distributors and impression rollers. The printing surfaces are rotary, and made as gravures to ensure clear production. For more than single-colour label work or for carton making, which requires cutting and creasing in exact relation to the printing, absolute register is secured by means of a perforating device. This machine can be thus built up for any particular class of work, the arrangement of inking, impression, and cutting rollers varying according to the number of colours required, whether straight or cross-cut, with or without creasing or bronzing; that is to say, a greater or lesser number of sections on the machine bed to suit the work proposed to be done.

For cutting and creasing the rotary engraved die for this machine can be made with circular projections having cutting and creasing edges for these operations, and if creasing follows the cutting in the same line, as is frequently the case in carton flaps and flanges, one projection is so shaped that part of it has a cutting and part a creasing edge. This ensures perfect register, and when cartons thus made are used for fine pulverised substances, such as table salt, cocoa, soap powder, etc., the packets thus made are powder-proof.

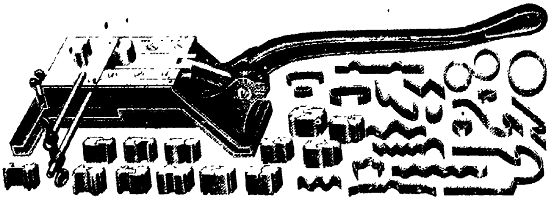
This advantage, of course, can be enhanced by continuing the glueing flange along the length of the carton blank, including the flaps, instead of cutting off the flange from the flaps. To ensure that the carton should be absolutely powder-proof, and also to preserve the contents in a better condition, an improvement has been added whereby a reel of greaseproof or similar lining paper is also fed into the machine. It is then glued to the carton board, and the glueing is specially devised so that when the carton is filled and sealed a powder-proof closure is effected.



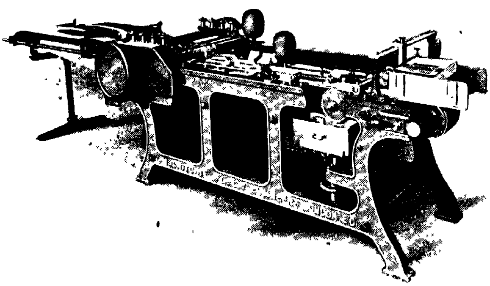
TYPES OF CARTONS, showing further varieties printed, cut and creased, ready for glueing, produced in one operation on a rotary multi-colour machine.

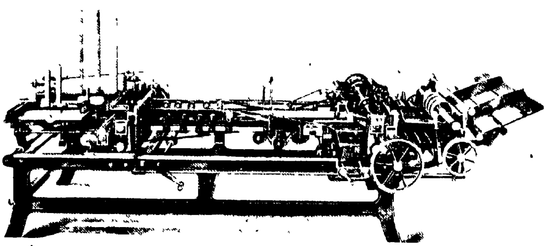
The engraved dies should be made of steel for long runs, as far as the print will allow, but for short runs and if one machine has to turn out varieties of sizes and designs photogravures made on hard phosphor bronze shells and steel faced will be found preferable. Another method of making these cartons in one operation from the roll is by printing, cutting and creasing them in strips containing six or eight; that is to say, with all the necessary cuts except the cross-cut, which separates one carton from another. Each strip is then glued and fed sideways out of the

Types of Rule Bending and Carton Glueing Machines.



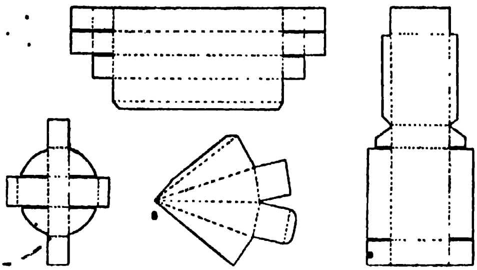
Steel Rule Bending Machine, with specimens of bent rule.





Automatic Carton Folding and Glueing Machines.

glueing machine into a rotary cutting attachment, which separates each carton and refolds it on the opposite edge to which it is glued.



TYPES OF CARTONS, in odd shapes, which can be printed, cut and creased in one operation.

There is another automatic punching and rotary machine which punches out, creases or scores, embosses and prints carton blanks in any shape and size from folding boxboard in the roll. At present the machine is made for one-colour rotary printing work, but the construction of machines for multi-colour printing is in preparation. The roll of board is fed centrally into the punching and printing mechanism, and the board unwinding attachment comprises a special frame. A double unwinder can be fitted so that two spools can be carried on one machine side by side.

For each size blank a special engraved printing roller is required, and the printing mechanism is fitted in a swinging frame to enable change of printing rollers in the shortest possible time. The inking mechanism is also easily movable. The capacity of the machine with a single tool amounts to 3,000 cuts per hour, and there is a stacking and counting arrangement to deal with the carton blanks. An automatic stopping device can stop the machine after 500 or 1,000 blanks have been punched out.

Slide Box Folding.

For confectionery, medicinal, and cigarette packing, there is frequently used a box having a rectangular cover or tube, into which a slide shell is placed. These slides are sometimes made as an upright covered box, but they can also be made like a carton; that is, cut and scored to proper shape and size, and then folded only to complete the slide. The ends are folded over and into the slide, which makes the box very strong where the strength is needed, and thinner boards can be used because of the double strength of the ends.

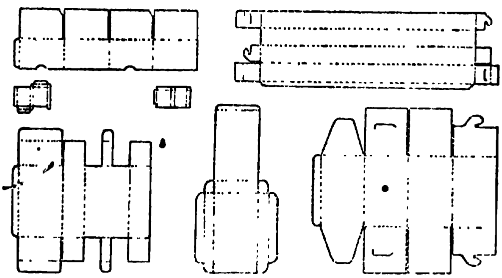
These slides or shells, having either double or single folded ends, are produced on a special machine, into which the prepared blanks are placed into a feed hopper and automatically fed. The machine delivers the slides folded on the lengthwise scores of the blank, which is then transversed at right angles, where the blank is finished at the delivery end in one continuous operation. No special skill is required to operate this machine, which handles either coloured or plain board, and will produce a set-up shell to take the place of the covered slide.

The output of the machine is about 2,000 per hour on double-folded ends, and 2,500 or more on the single-fold variety. It has a range of from 2 inches long by 1¼ inches wide by ⅜ inch deep to 5½ inches long by 4 inches wide by 1½ inches deep. This covers the smallest druggist's box to that of a one-pound confectionery box. About twenty minutes are required to change from one size of box to another, and no glueing operation is necessary.

Glueing the Cartons.

After the regular carton blanks have been printed and creased, they are ready for glueing and folding. This operation can be performed on a variety of machines from a small one for table use, which glues only, to a large automatic machine, which not only glues the cartons, but folds, stacks, and counts them. The table folding box gluer has

a glue wheel, over which the blanks are passed in the flat. A gauge and a deflector guide them over the wheel. The blanks are then folded by hand and passed through a series of pressure rolls, where the glued flap is rolled down and set. The amount of glue is regulated by a scraper, which is provided with a lock-nut adjustment, and the pressure of the rolls regulated by hand-screws.

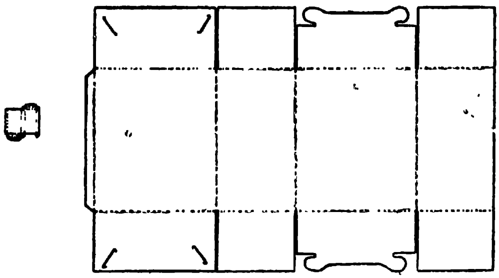


FOLDING BOX GLUEING, showing various types of carton blanks, which are automatically glued, folded, counted and stacked in one operation.

A similar machine on an iron frame and stand is also obtainable, and both are regularly furnished with a steam heater glue pot, but gas or electric heating can also be supplied. A much larger machine of another make takes up the blank, folds and glues it up one side before delivery. For this machine a special style of blank is required, which is obtainable by a simple re-arrangement of the usual printing plates and a new cutting and creasing formie. With this kind of carton, the machine will produce from 1,200 to 1,800 complete cartons per hour.

The automatic machine for glueing, folding, pressing, stacking, and counting the cartons takes a continuous stream of blanks from a pile, passing them through the machine without a stop, and delivering them complete at a speed varying from 300 to 700 per minute, according to

the size of the blank. Speeds of 1,200 to 1,400 per minute have at times been reached and maintained for long runs. The feeding mechanism is entirely automatic, and is operated so that highly finished and embossed work can be handled without being defaced. After the blanks have passed over the glue wheel, the folding is done by means of turned belts, which cause the two flaps to be folded as the blank is carried forward, one flap being pressed down against the other.



Folding Box Glueing, showing wide range in sizes of carton blanks, drawn to scale, which can be handled on the automatic glueing and folding machine.

The changes for different sizes can be made quickly, and on one of these machines cartons from $1\frac{1}{2}$ to 16 inches in width when folded can be taken, while on another the range of sizes is between 3 and $20\frac{1}{2}$ inches wide, folded. A great deal of the success of these machines depends upon the accuracy of the adjustments for sizes, and equally great care should be taken of the oiling. Probably about two hours is not too long for setting time allowance on a folding box gluer. A great deal of fine dust that comes off the cartons is apt to clog the oil holes. It has been found advisable to link up an automatic tying machine with the folding box gluer, to keep the stacked cartons in neat piles for delivery.

FILLING AND SEALING THE CARTONS.

There is a series of machines on the market which will fill, weigh, seal, line, wrap and label folding boxes automatically. In this set of pneumatic machinery, the cartons, as they leave the folding box glueing machine are conveyed automatically on the feeding block of the bottom sealing machine. The carton is securely and tightly sealed at the bottom under pressure and, if desired, it may be embossed with a private mark, or a date, from steel type in this operation.

A conveyor belt now carries the carton to the filling and weighing machine. From the first hopper of the filling and weighing machine, a rough load is automatically placed in the carton. From this point it is carried by successive steps, being settled as it progresses, until it reaches the scale pan, which is under a second load or fine stream hopper, which gives it its true weight. It then travels along to the top sealing machine, where the flaps are folded and securely sealed and the cartons delivered on to a conveyor having a top and bottom belt with pressure rolls, for setting the glue, thus making a tightly sealed package. The cartons travel to the end of the dryer belt, where the package places them in slipping cases.

Through the use of a machine known as the pneumatic carton feeder, the knocked down cartons are fed automatically from a supply stack to the bottom sealing machine, to which it is readily attached, and thus permits one to operate a complete set of pneumatic packing machines without employing a single operator. These pneumatic machines are built on the unit basis of design, each being complete in itself, but constructed to run harmoniously with any related machine. Varying work is easily handled by convenient and quick adjustments, and a series of interchangeable parts for the various machines make it possible to pack a wide range of sizes. All kinds of loose flowing material, such as sugar, coffee, tea, rice, spices, etc., are easily handled.

This process completes the various operations associated with carton manufacture, and the next kind of box to be described will be the upright wire stitched box, which is rigid and held together by means of wire pierced through the cardboard, or flat metal strips secured along the corners.

§ 5

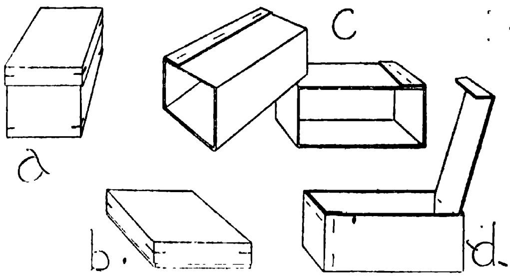
THE UPRIGHT WIRE STITCHED BOX.

A DISTINCTION has been drawn between the upright (rigid or set-up) box which is wire stitched and the collapsible wire stitched box, though both kinds may be used for similar purposes, because the methods of preparing the blank are different. In the class dealt with under the "upright" category, boxes are made from stout strawboard and imitation leatherboard, as well as from solid and corrugated fibreboard, though the latter materials are superseding the former because of their growing superiority.

The upright fibreboard box of the present day is much superior to what it was ten years ago, when it was more or less of a flimsy construction. Modern solid fibreboard boxes of the better grades will stand firm under excessive piling and resist the hardships and hard knocks of railway and shipping transportation. Both they and corrugated boxes are now used extensively for the packing of all manner of heavy articles which are to be delivered hundreds of miles away, though many varieties are made for packeting numerous domestic hardware articles.

The two methods of making the upright wire stitched box are similar in certain operations to two kinds of the upright covered box, namely, the one-piece and the three-piece. The similarity exists in the style of blanks used for both varieties, that is to say, one piece of board for the one-piece upright wire stitched box, and three pieces for the other. Except for cutting out the corners in the one-piece blank, there the similarity ends. For making the bends

in the blank to form the sides of the box, a bending machine is used instead of a cutting and scoring machine, and the box is held together by a series of tinned or coppered wire stitches.



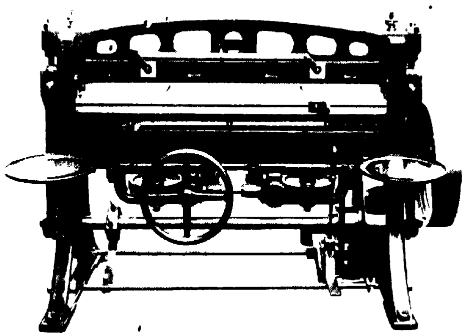
TYPES OF UPRIGHT WIRE STITCHED BOX, showing (*a*) a one-piece, slip-on lid; (*b*) a one-piece telescope; (*c*) inner and outer of two-piece slide; and (*d*) a two-piece flap box.

BENDING THE BOARD.

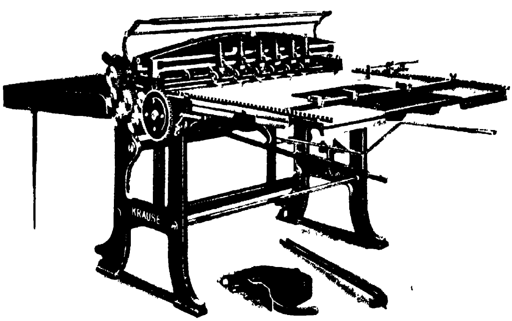
As the board used for an upright wire stitched box is generally heavy or thick, it has been found desirable to make the creases on a bending machine as a separate operation, so that when folded the loosened fibres draw tightly together and form a stiff, strong, shock-resisting corner. This machine can be used for either solid or corrugated board, but it should be remembered that the latter material does not lend itself readily to the manufacture of a one-piece box and is therefore adapted for the three-piece variety. As few kinds of upright wire stitched boxes are made from corrugated board, it will be understood that the descriptions which follow deal mainly with solid board.

The board is fed with the outside of the sheet to go into the female die, thus throwing the welt on the outside of the box. The action of bending the board results in the least possible injury to the material and enables the board to be bent without being weakened. The bending operation

Types of Vertical and Rotary Board Bending Machines.



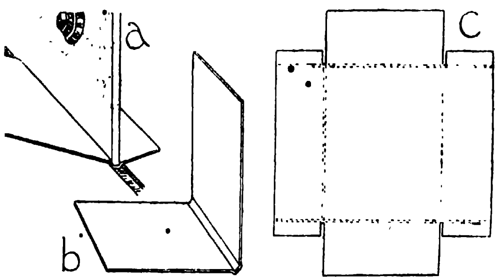
Heavy Pattern Vertical Bending Machine.



Combined Rotary Cutting and Double Beam Bending Machine.

is obtained by the positive downward stroke of the straight upper bar in the lower or female die. Another advantage is that none of the space inside the box is taken up by this bend.

For the upright wire stitched box the bending machine can handle long sheets of board, for forming the panel bends in the one-piece box and for making the rectangular tube of the three-piece box. The board comes to the machine trimmed and slit to size. One operator on the feeding side passes the sheet for the first bends, while another operator on the delivery side advances the sheet step by step for the other bends, and piles the finished sheets ready for the next operation. The machine has suitable stay end gauges which serve to guide the sheet for each course. When the sheets of board are small or of medium size, so that they are less than half the length of the bending dies, two operators can work simultaneously, one on either side of the machine. Independent depth gauges are provided to suit this operation, which doubles the output of bent sheets.



Bending or Creasing, showing (*a*) the bending or creasing operation; (*b*) a piece of board bent or creased; and (*c*) a one-piece blank creased and slotted (the dotted lines representing the creases).

There is also a combined rotary cutting and double beam bending machine for creasing and cutting up into small size blanks large sheets of better grade material such

as leatherboard and superior lined boards. The bending process is an improvement in such cases over scoring because it does not weaken the board and the output is much greater than is possible on a vertical bending machine.

PREPARING THE ONE-PIECE BLANK.

If the box is shallow, as with the shallow one-piece upright covered box, the corners are cut out on a heavy corner cutting machine of a similar pattern to that described previously.* This enables the sides of the box to be turned upwards on the bending line, ready for wire stitching to form the box body. The lid for this and the three-piece box is made in this manner, when it is of the slip-on variety. There is, however, a popular type of one-piece box, used for packing clothes and similar goods, for which the blank has no corners cut out. Instead, one side of the corner strip is slotted and then bent inwards to form a stitching flap. The slotting operation can be done on a machine of that name, which will be described later.

A machine can also be obtained for producing one-piece box blanks, ranging in size from the smallest to the largest, with slots, stitching flaps, and creases (bends) in both directions, all formed in one passage through the machine. This automatic creasing (bending) and slotting machine is set into motion by the insertion of the board sheet, and for the one-piece box four strokes are required to complete each blank, the machine automatically stopping at the end of the fourth stroke. It is started again by the insertion of the next sheet. If the box is of the "built up" type, two strokes are required to complete each section.

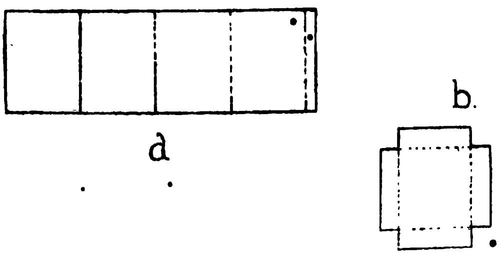
The operation performed on the sheet of board as it passes through the machine consists of flap creasing, lengthwise of the sheet, and panel creasing, crosswise of the sheet, together with the cutting of all the slots and stitching flaps. During the passage of the sheet through the machine it is held securely in position, so that the distance between the creases, slots and cuts is accurate. The board

* See page 18.

sheet is fed into the machine, slit accurately to width and trimmed to the approximate length. Any variation in length is provided for by a variation in the stitching flap, thus becoming wider or narrower, as the case may be. Further varieties of this machine will be found in the section dealing with collapsible wire stitched or taped boxes.

PREPARING THE THREE-PIECE BLANK.

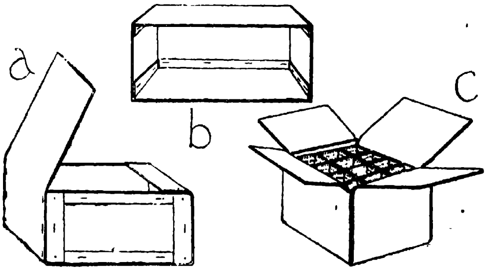
One form of the three-piece blank for the upright wire stitched box has its body made in a rectangular tube shape by being cut to length and width on the rotary slitting machine, and then bent in four places on the bending machine. This rotary slitting machine can take any thickness of board, though a less heavy pattern is supplied for medium sized sheets. The feed rolls on the receiving end hold the sheet in perfect alignment while it passes through the slitting knives, and as the machine is arranged conveniently for the operator a large output is possible. This machine is also used for trimming and cutting to size solid and corrugated board sheets which are to be fed into the automatic creaser and slotter and other machines which form the one-piece blank.



BLANKS FOR THE THREE-PIECE BOX, showing (a) the tubular body blank; and (b) the cover (top and bottom) blank.

There is also a variety of three-piece box which is reinforced at the ends with a thin wooden frame, made from four wooden laths, wire stitched to form a square. One

piece of the board is bent four times to provide the flap, back wall, bottom, front wall, and flange for the flap, and its edges are fastened by staples or nails to the edge of the wooden frames. The remaining two pieces of board are attached to the frames to make the ends of the box.



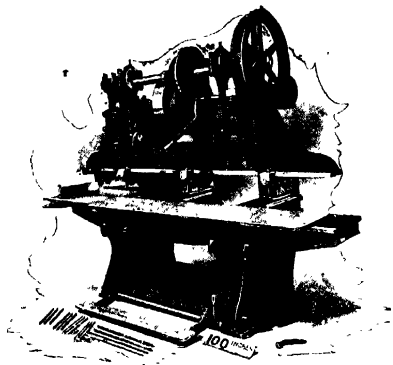
TYPES OF THE UPRIGHT WIRE STITCHED BOX, showing (a) a three-piece wood end box; (b) a three-piece, slip-on lid box; and (c) a three-piece corrugated box.

The three-piece corrugated board blank is practically three shells which fit into one another to form the box, one or two of the shells supplying the closure flaps, according to whether two or four flaps are needed. Each sheet for this blank is trimmed on the rotary slitter and then placed on the bending machine, or else dealt with in one operation on the rotary creasing and slitting machine. As the latter machine is used more frequently for the manufacture of blanks for the collapsible wire stitched or taped box, it will be fully described in that section. The corrugated partitions sometimes inserted in these upright wire stitched boxes are prepared on a slotting machine.

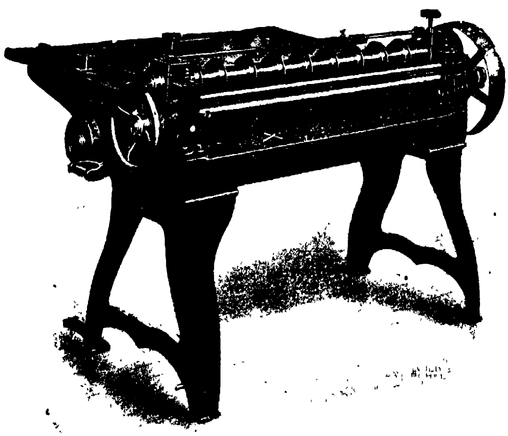
SLOTTING AND FLAP CUTTING.

For certain kinds of boxes it may be required to have slots and flaps cut in various ways, and for this purpose there is a combination machine which, at one stroke, cuts a set of slots of equal depth in either corrugated or solid fibreboard. For either kind of board the flaps may be

Types of Slotting and Slitting Machines.



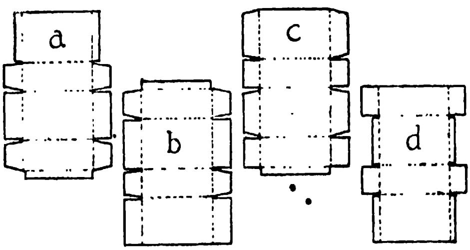
100 in. Slotting and Flap Cutting Machine.



Heavy Pattern 45 in. Rotary Slitting Machine.

trimmed to meet exactly, but in a solid board box a stitching flap is usually formed at the same time. This machine is designed for performing all the cutting that may be necessary on the heaviest and largest sheets of board, in order to form them into any of the shapes shown in the accompanying illustrations.

For cutting solid board blanks, either straight-sided or tapered slotting knives can be used, but for corrugated board only the former. The flap cutting knife will trim one closing flap on each side of the blank, and these flaps can be trimmed back any distance from the edge of the blank. The main advantage of this machine is that at one handling blanks are slotted so that all the flaps of the one-piece box meet when folded over.



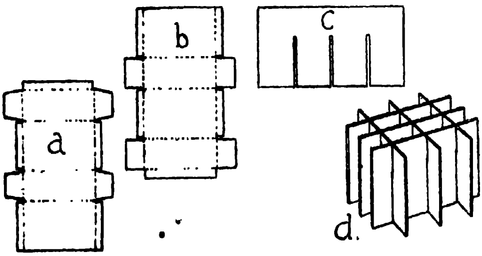
Blanks for the One-Piece Box, showing (*a*) and (*b*) fibreboard blanks slotted to give a tapered edge to the outer closing flaps; (*c*) fibreboard blank as (*a*) and (*b*) but with tapered end flap; and (*d*) corrugated board blank, with all opposite closing flaps of equal length and meeting in the centre when folded.

This combination slotter and flap cutter can be run continuously or under foot control. In the latter action the clutch picks up its load instantly without strain on the parts, and the machine may stop at the top of the stroke when the treadle is released. Liners of different thicknesses are provided shimming down the knives as they become shortened through grinding, and whereas the knife

equipment should be of the straight edge type for soli board, a serrated cutting edge will be better for corrugate board. The box blanks, as they come from this machin are ready to be wire stitched.

PARTITION SLOTTING.

Though the manufacture of partitions, which fit insid some kinds of the upright wire stitched box, would perhap be described more suitably after the formation of the bo has been dealt with, this operation is referred to no because it can be done on the machine just mentione Slotted partitions are used for chocolate and confectioner boxes, as well as for bottle, egg, and similar corrugate or fibreboard boxes.



BLANKS MADE ON THE SLOTTING MACHINE, showing (*a*) and (*b*) varied blanks for the one-piece box; (*c*) corrugated board bottle partition; and (*d*) set of partitions assembled.

The blanks are first cut to the required size, and o the smaller sizes the stock can be cut twice the lengt and slotted and cut in two in one operation. On one kin of machine for this work there is an automatic feede whereby one blank is fed and slotted per revolution. Co sequently, the operator has merely to keep the hopper fu of sheets, as the delivery is made into any suitable tra or on a table as required. Small confectionery partitio blanks can be fed two or three at a time by means of narrow push bar.

Corrugated board partitions, however, can only be fed one at a time, and the wide push bar is then brought into action. This will ensure parallel feeding. Adjustability to produce slots of varied depth and width is very simple, and though the output depends on the size and kind of partition required it should be possible to obtain at least 100,000 in a working day, and on some small jobs as many as 300,000 have been produced.

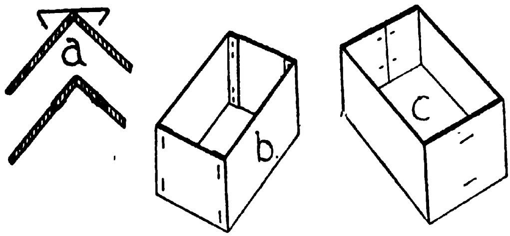
FORMING THE WIRE STITCHED BOX.

After bending and slitting (or slotting), and also corner cutting in the case of the shallow one-piece box, the blanks for both the one-piece and three-piece box are ready for formation on the wire stitching machine. It will have been observed that some of the blanks for the one-piece box are not provided with stitching flaps and for this kind after the sides are bent upwards to form the box body the stitches inserted round the corners join them as corner stay paper does those of the upright covered box. Different styles of wire stitching machines are therefore required for this box to what are necessary for the box with stitching flaps.

For the wire stitching operation, a great variety of machines have been invented during the past thirty years, and improvements are being made continually. It was claimed for wire stitching in the early days that it greatly increased the strength of the box and superseded the old system of glueing. This may have been the case before the present non-odorous and tasteless adhesives and strong kraft stay paper came into use, but it can hardly be aplied so generally now. Nevertheless, for heavy material such as fibreboard a stronger fastening than stay paper is required, though stay paper is applied at times before the wire stitching to enhance the strength of the box and make it neater in appearance.

The principle involved in wire stitching is simply that of driving a short piece of wire through the board, the two ends being bent inwards to make the stitch secure. The

wire is supplied on wooden or metal spools, or in coils to fit on spools, and is fed continuously through the machine, the spool revolving for this purpose on an attached spindle. A gentle pressure on the treadle will cut the wire to the required length, drive it through and clench it firmly to the board on one operation. On certain machines there are regulating adjustments for the different thicknesses of board used.



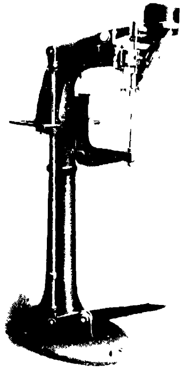
Round Wire Stitching, showing (*a*) the wire cut and bent before and after insertion in a sectional view of a corner of the box; (*b*) a box with parallel wire stitches; and (*c*) a box with cross wire stitches.

Stitching machines are made specially for different kinds of work. One machine will insert a wire stitch parallel with the box corner; another will make a right-angle corner stitch; while a third is much used for boxes cut in one piece with the ends left on and the sides brought round outside, so that the box is stitched across the centre. The most up-to-date machines possess a clutch, operated by a foot pedal, which enables one or two more stitches at a time to be inserted continuously; the adjustments are automatically made after the thickness of the board is allowed for; and the feed of the stitching wire is so arranged that it is taking place while the previous stitch is being clenched.

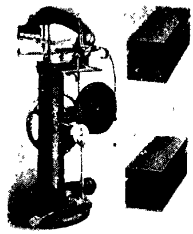
Generally, round wire of varying thicknesses* is used for upright wire stitched boxes, but for corrugated board

* For dimensions, weights, etc., of stitching wire, see page 214.

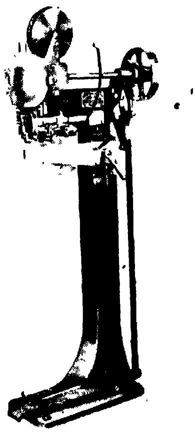
Types of Stitching and Rivetting Machines.



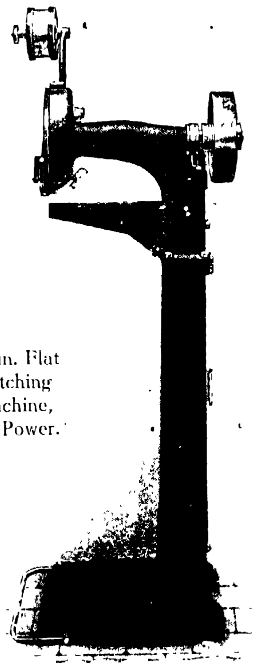
Rivetting Machine arranged for Bottom Rivetting.



Metal Edging Machine, showing edged boxes.

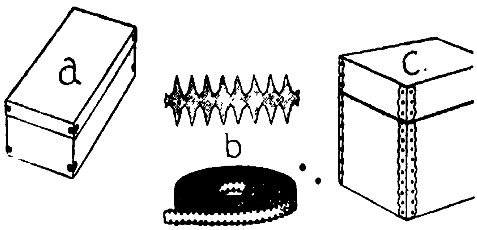


Variable Feed Straight Wire Stitching Machine



12 in. Flat Stitching Machine, for Power.

and certain other kinds of boxes, either narrow or broad flat wire is adopted, to make the fastening more secure. As stitching wire which does not rust is tinned, this kind should always be specified. Not so frequently used now for corner fastening is metal edging, which is applied by a machine similar in construction to the wire stitcher. Another method of box fastening which has had popular usuage is rivetting, which is also done on a similar machine, the metal used being rivet strips. Present day forms of box decoration have removed the necessity for a lengthy corner strip of perforated metal, and wire stitching provides just the fastening required. For certain kinds of boxes, particularly those which have to be used over and over again, both metal edging and rivetting will be found very serviceable to keep the box corners firm.



FLAT WIRE STITCHING, showing (*a*) a box with flat corner stitches; (*b*) a coil of metal edging and a piece of rivet strip; and (*c*) a box fastened with metal edging.

After the wire stitching operation, the box is ready for use, except for labelling or decorating, according to requirements. Though the operations involved are not so numerous as for the upright covered box, they nevertheless require much more practical knowledge in execution, because the style of the box varies according to its uses. Many upright wire stitched boxes are now being made to hold goods for railway transit, and a special classification of those containers has been passed by the railway com-

panies on both sides of the Atlantic for goods traffic. These railway containers being subject to hard usage, extra attention must be given to their manufacture, and a great deal of care to obtain satisfactory methods of sealing when the containers are filled. This subject will be dealt with in the next section, as it is more directly connected with the collapsible wire stitched or taped box which is being developed so considerably as a packing case.

§ 6

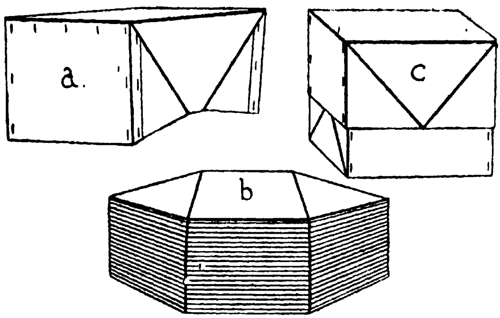
THE COLLAPSIBLE WIRE STITCHED OR TAPED BOX.

THE principal difference between the kind of box now to be described and both the upright covered and wire stitched boxes is that the latter two styles are made upright, or rigid, and remain so when the box is completed, whereas the former style, like the carton, is so made to enable the box to be stored in a flat condition before it is required for filling. This frequently entails the bending or creasing of the blank in addition to the usual creases by which the sides of the box are formed. This operation is performed on the bending machine either while the usual creases are made or in a separate operation.

The material used for these collapsible boxes can be either fibreboard or imitation leatherboard, though certain good grades of strawboard, which are not too brittle, have also been used when covered with a stout lining paper. There are also a series of collapsible boxes made from corrugated board, to which a special section will be devoted later. These are not wire stitched, but taped or stayed, and are generally constructed so that the various parts can be assembled together from the flat condition to form the box when required for filling. For the general kind of collapsible wire stitched or taped box the blanks are prepared on the automatic creasing and slotting machine, as for certain kinds of the upright wire stitched box, the folding condition being obtained through the ordinary creases.

These collapsible boxes have become very popular in

recent years as packing cases for goods traffic by rail or sea, and in fact are known as fibreboard packing cases in the British Isles, or as shipping containers in America. The corrugated board box, particularly, has proved to be specially useful for the packing of glass, earthenware, and other fragile goods. In both the medicinal and electric lamp industries, many boxes of this kind are now employed, while an endless range of every day commodities, such as nails, screws, brass fittings, tins of boot and other polishes, bottles of ink, condensed milk tins, knives, pipes, varnishes and paints, wire, etc., are now being packed in fibreboard boxes.

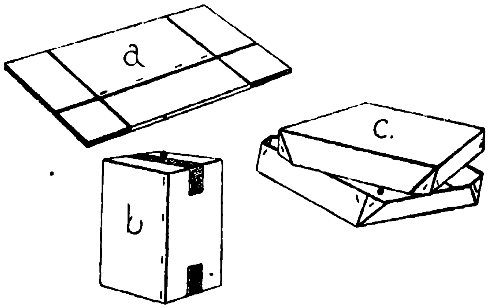


Collapsible Wire Stitched Boxes, showing (a) cover of a packing case partially bent; (b) twenty packing cases in a collapsed condition; and (c) a packing case partially closed.

THE MAKING OF THE COLLAPSIBLE BOX.

Before each process in the manufacture of this box is described in detail it would be well to outline in general the sequence of the processes. In the case of solid fibreboard boxes, the component parts of the board are pasted together, making the various thicknesses called for by the classifications, and then the sheet for the blank is cut to the dimensions of the box. If the box is to be printed, these blanks are taken to the printing department, where

they are stamped with the customer's name or brand, as the case may be, and passed on to the slotting and creasing room, where automatic machines do the work of preparing the blank for setting up or stitching. The next step is to the finishing or stitching department, where the boxes are put together by a series of tinned or coppered wire stitches. The boxes are then ready for use.



COLLAPSIBLE WIRE STITCHED BOXES showing (*a*) a one-piece packing case in a collapsed condition; (*b*) the same case filled and closed with sealing tape; and (*c*) a costume box and lid.

In the case of corrugated board containers linen tape is also used for joining the blanks together to make the box. The preliminary operations for corrugated board boxes, namely, the forming of the sheets into the desired length and to trim, slit and crease the sheets, can be done by attachments to certain types of the board making machines, as referred to previously.* The travelling shear attachment for corrugated board, for instance, does away with inaccurate cutting. The shear is operated by the front end of the paper striking a trip plate on the delivery table, which mechanically throws in the clutch.

Adjustments for change in sheet lengths are made quickly without stopping the machine, and the shear is regularly furnished to cut board up to 60 inches wide into

* See page 7.

sheets 36 to 120 inches long. A similar shear is supplied to be attached to fibreboard pasting machines. At the cutting end of the corrugating machine equipped with this travelling shear there may be fitted a double stand of mandrels carrying adjustable slitting and creasing knives. These enable the sheet, as it comes from the machine, to be creased one way across the corrugation and to be slitted at any point required, as well as to be trimmed. The four mandrels are so arranged that either pair can be set for the next run while the other pair is in use.

Printing the Box Board.

The sheets for both upright and collapsible wire stitched fibreboard boxes are dealt with similarly for printing purposes. There are multi-colour printing presses obtainable in different sizes which are built specially to handle two or three colour work for containers. On one type of this press the board passes through the press the short and stiff way of the sheet, and as the press is fitted with slitting and scoring knives it will also trim and score the sheet in one direction.

Single sheets can be fed from a hopper, and it is possible to run two different kinds of work through the press at the same time by means of a simple adjustment. There is a spirally grooved type cylinder for holding metal backed printing plates, or maple lagged cylinders can be equipped to which rubber type can be tacked. With this method the rubber type is glued, for each colour, to a sheet of strong board the size of the panel to be printed, and in this way the type can be registered colour for colour in the flat before being tacked to the cylinder.

Another form of decoration, used frequently for leatherboard boxes to contain dresses, millinery, and such goods, is known as "cutta crush" work, or cut-out embossing. This is done on an embossing press, by means of a male and female die. The male die is furnished with a cutting edge, and a delicately surfaced paper is laid over the board, the downward pressure of the head of the press

fixing and cutting the paper to the design or lettering required.

PREPARING THE ONE-PIECE BLANK.

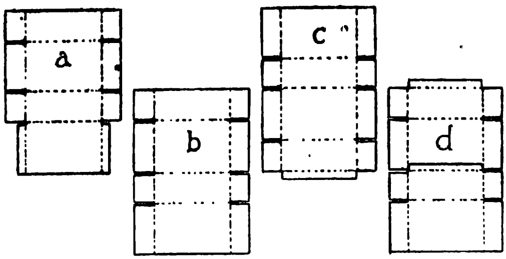
The vast majority of boxes that are of the collapsible, or packing case variety, are made from one piece of board, the blank for which is bent and slotted by the automatic creasing and slotting machine. In one kind of this machine the range of size for making the one-piece slotted box is from 6 by 8½ by 6 inches in depth to 28 by 82 by 80 inches in depth, and this range will cover nearly all sizes of boxes used commercially. The blanks for the different types of this kind of box are prepared on one of three varieties of creasing and slotting machines, according to the class of work to be handled.

One variety handles solid fibreboard only and is fitted with auxiliary trimming knives for producing the stitching flap. The board sheets fed to this machine must be trimmed previously to width and to approximate length. A second variety is fitted as a four-stroke machine for the production of the one-piece folding end box, which is made of one piece with one stitching flap. It is interchangeable to a two-stroke machine for making the built-up one-piece box, which is formed of two pieces with two stitching flaps at diagonally opposite corners. This machine has an auxiliary set of belts on the delivery end with a corresponding sectional table to ensure proper handling of the shore sections.

The third variety in interchangeable to handle either light or heavy weight solid fibreboard; producing either of the boxes just described. With the equipment furnished it is possible to produce a blank with a wide panel crease, and a standard width of slot, so as to give a tight corner without sacrificing adjustability for various depths of box. In addition to the flap creases and slots, panel or cross creases are required, and these are formed on a special attachment.

For certain boxes it is desirable that the panel or cross

crease be formed in the blank separately from all other work done upon it. This refers particularly to those boxes which are made of thick board, in which are packed commodities requiring a smooth interior corner of 90 degrees, without welt or bulge, which, when it occurs, tends to injure the boxes in which the goods are packed. For this operation the panel creasing attachment can be fitted at the delivery end of the automatic creasing and slotting machine. The entrance of the blank into this attachment automatically trips the clutch and starts it in motion. The sheet is thereby brought to correct register, and the four panel creases are made consecutively.

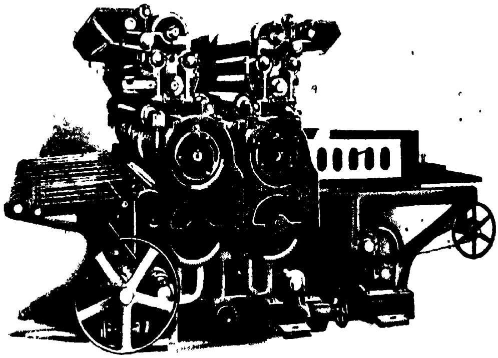


BLANKS FOR THE ONE-PIECE BOX, showing (*a*) corrugated board blank, with all closing flaps meeting when folded; (*b*) corrugated board blank, with one pair of closing flaps meeting when folded, unless the box is square; (*c*) fibreboard blank, with stitching flap; and (*d*) fibreboard blank made in two pieces, and stitched together.

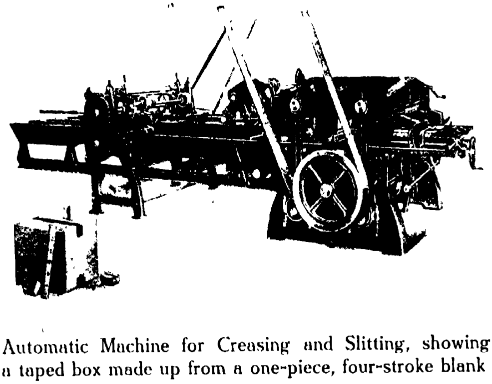
ROTARY CREASING AND SLITTING.

Another method of preparing the collapsible box blank, and most frequently used when the material is either thin solid or double-faced corrugated board, is on a special kind of rotary creasing and slitting machine. This machine is also supplied for single and double work, that is to crease and slit the board one way or in both directions, the double creaser and slitter performing the latter operation with one passage through the machine.

Types of Printing and Slitting Machines.



Printing Press for Fibreboard Packing Cases.



Automatic Machine for Creasing and Slitting, showing a taped box made up from a one-piece, four-stroke blank

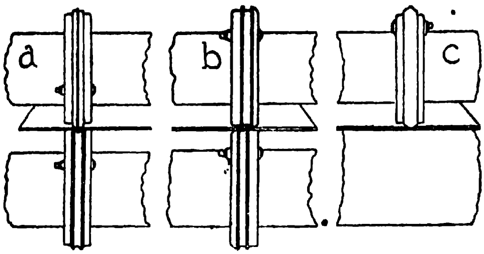
On the double rotary creaser and slitter the sheet is first operated in the direction of its length and then automatically cross fed in the direction of its width. This machine is of the eight mandrel type, one set carrying the slitting knives and one set the creasing knives of each member. For fibreboard heavy top and bottom supporting bars are fitted on the second member of the machine for carrying adjustable centre bearings, and this ensures ample strength to counteract the thrust incurred in creasing this kind of board.

In operation the sheet of board is placed against the stop plate, which prevents the machine being clogged by another sheet being fed before the preceding one has travelled far enough to leave a clear field. The machine can be speeded in accordance with the skill of the operator by means of a feed governing device which enables the sheets to be taken faster or slower as desired. A device has also been supplied by means of which the number of strokes per minute of the stop plate stripper can be varied, as well as that of the feed gauge which automatically feeds the sheets through the second member of the machine. The result is that, when short sheet lengths are being handled, almost the same quantity of board is passed through the machine as when it is working on long sheets, and a greater output is obtained.

The single rotary creaser and slitter is made in two styles, one for handling corrugated and the other for fibreboard. The creasing knives may be raised out of contact with the board without disturbing their spacing when cutting only is required. On the creasing and slitting machine for fibreboard the upper creasing mandrel is vertically adjustable to suit the thickness of board or to obtain any depth of crease. The creasing blades for this board are male and female to produce a uniform double crease.

When corrugated board is being run through this rotary machine, for creasing across the corrugations a double rib creaser is used. This makes a uniform double hinge crease which enables the board to be folded either way

with the least possible injury to the blank. It is particularly desirable for the end-flaps of the one-piece container, as the flaps are usually bent outwards by the packer to permit easy filling of the box.



THE PRINCIPLE OF ROTARY CREASING, showing (*a*) double rib creasing for fibreboard; (*b*) double rib creasing for corrugated board across the corrugations; and (*c*) single rib creasing for corrugated board along the corrugations.

When the corrugated board has to be creased along its corrugations a single rib creaser may be used with a large diameter under roll. With either single or double faced corrugated board the crease made in this way enables the sheet to be folded easily and without harm. This creaser can also be used for producing a single crease across the corrugations. If the box blank is made on the automatic creaser and slotter, or on the creasing machine and then on the slot and flap cutting machine, it is ready for forming into a box on the wire stitching machine. It should be noted that one-piece boxes made from corrugated board are rarely wire stitched, being formed instead at the corners with stay paper on the heavy pattern corner staying machine, as for the one-piece upright covered box.*

Small collapsible boxes, when made of better class materials, may have their blanks prepared on the combined rotary cutting and double beam bending machine, as is

* See page 20.

also used for making the upright wire stitched box.* This machine can be fitted with an automatic cross gauge to the front table for four different speeds, and with precision gauges having automatic sheet adjusters.

PREPARING TWO- AND THREE-PIECE BLANKS.

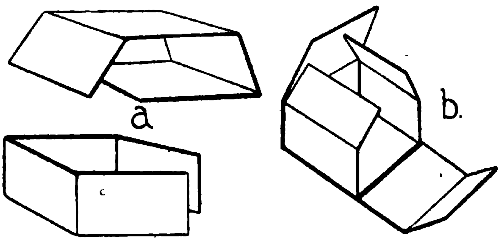
The blank for the two-piece collapsible box of this description consists practically of rectangular shells. The dimensions of the box govern the length and width of the board strip used for each shell. The board sheet is fed into a rotary slitting machine, the cutters and feed gauges of which are adjusted to the required dimensions, and then the trimmed strip is given four creases on the creasing machine—three to form the tube end and the fourth the stitching flaps—after which it is ready for the corner staying or taping machine, and for completion. Other types of two-piece box blanks will be described in the section dealing with corrugated taped boxes.

Practically the same operations apply to the manufacture of the three-piece box if it is made from corrugated board. When made from solid board the processes involved are similar to those applied in making an upright wire stitched box except that before the three pieces of cut and bent board are stitched two opposite sides receive V-shaped creases to enable the box to be collapsed. This class of box is used considerably as a packing case, and it has been customary to make it with a slip-on lid of slightly greater depth than that of the box body. V-shaped creases are also made on two of the lid sides opposite one another but not on the same sides as those of the box body, as shown in the illustration "c" on page 94.

Three-piece corrugated blanks are frequently made as three separate one-piece blanks, and slipped round one another to form the body and lid. These one-piece blanks, used frequently as sleeves or shells, either square or octagonal in shape, to slip over bottles, are prepared on a different machine, which produces them from rolls of single-

* See page 83.

faced board. This board is cut to width, scored, and re-wound on a combination roll slitter, scorer, chopper, and re-winder. The prepared roll is fed through the corrugated shell machine with the corrugations running lengthwise, and it is folded, taped and cut to length automatically at a speed of from fifty to one hundred per minute.



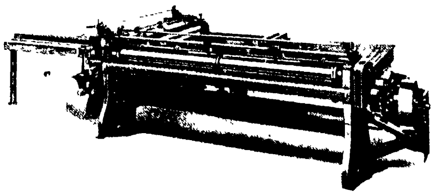
BLANKS FOR THE TWO-PIECE BOX showing (a) those for the telescope or double slide box, each blank being creased three times; and (b) those for the corrugated board folder, each blank being creased four times.

TYPES OF TAPED CORRUGATED BOXES.

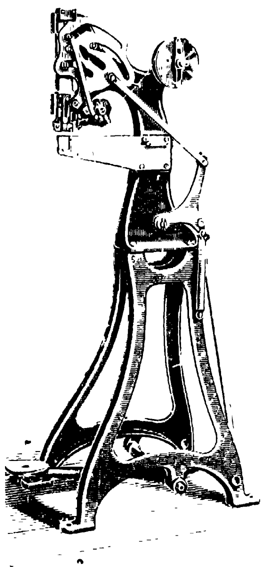
These collapsible corrugated packing cases, or shipping containers, require a section to themselves because there are so many varieties. For the purposes of manufacture the different kinds will be classified under three headings, the one-piece, the two-piece, and three-piece box.

One-Piece Boxes: The most important of this series are of the slotted pattern because they are adapted to contain so many commodities. One style is so made that the outer flaps meet at the centre of the box, while the inner flaps do not meet. When the article shipped does not require the protection afforded by two thicknesses of corrugated board over the entire areas of top and bottom, this container is very safe, convenient and satisfactory. It may be sealed either by glueing the flaps or by completely covering all outer joints, openings or seams with

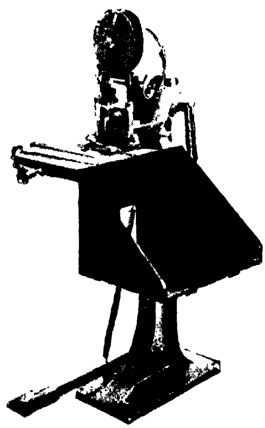
Types of Slitting and Wire Stitching Machines.



69 in. by 120 in. Double Rotary Creasing and Slitting Machine. (8-bar type for corrugated Board).

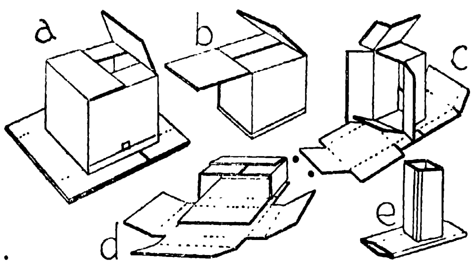


Straight Wire Stitching Machine.



8 in. Continuous Feed Collapsible Box Wire Stitching Machine.

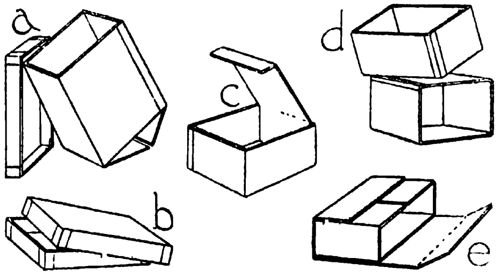
paper sealing strips. Another style is made with the inner flaps, as well as the outer, meeting at the centre, giving more strength to the top and bottom. Both of these varieties are also made with the outer flaps being able either to completely or partially overlap one another, giving more protection to the contents. Some of these boxes are made from two pasted double-faced sheets making a double wall for each side, top and bottom. Then there is the five panel folder, used as a container for books, umbrellas, etc., the flaps of which may be glued together and the joints taped; the one-piece folder, which has nine panels and is sealed by being glued or taped; and the single- and double-faced tube, a four-sided taped container without top or bottom, and the same blank not taped at the joint but with a stout paper wrapper glued round the outside with projecting ends to fold in.



TYPES OF ONE-PIECE CORRUGATED BOXES, showing (*a*) the centre slotted; (*b*) the full flap slotted; (c) five panel folder; (*d*) one-piece folder; and (*e*) single or double faced tube.

Two-Piece Boxes : One type of this box differs from the slotted pattern of the one-piece box only because there are no flaps at one end, a shallow lid being used instead. When a lid of this kind is made to fit over a shallow body the telescope variety is formed. One type of the slide box is made from two pieces of board, one piece making the

sides and the other the top and bottom; while the double slide box is made in two taped four-sided shapes one fitting within the other. The two-piece folder is made similarly but not taped until filled.

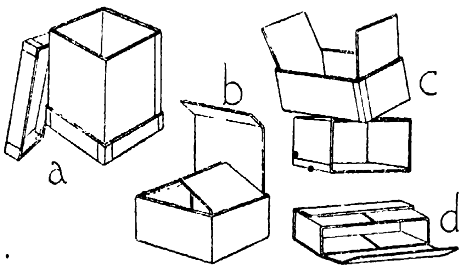


TYPES OF TWO-PIECE CORRUGATED BOXES, showing (*a*) the half slotted; (*b*) the telescope; (*c*) single lined slide; (*d*) double slide; (*e*) two-piece folder.

Three-Piece Boxes: The chief of this series is the double cover box, which is merely a four-sided taped body with separate top and bottom covers. If the goods do not fill this box the body is cut down to the level of the contents. Extra covers are then purchased so as to make a complete box out of the part of the body not used. This style of box is extensively used for the shipment of millinery, artificial flowers, etc., but may be used for practically all kinds of merchandise. The body of the box is folded flat and packed separately if the covers are to be furnished with collapsible corners, which are secured with heavy cloth tape. Then there is the three-piece slide box, which is similar to the two-piece box except that a third five panel folder is inserted to give three thicknesses of board all round; and there is also a similar variety of the slide box, giving two thicknesses of board each way. Finally, there is the three-piece folder, which has proved advantageous for packing commodities of varying sizes.

TESTING AND SEALING PACKING CASES.

Considerable importance attaches to the closure of these fibreboard packing cases for railway and shipping traffic if the contents and the case are to be well preserved. There has been designed, for the purpose of discovering the strength of a railway container, a drum box testing machine, into which the filled box is placed and then rotated to represent the rough knocks, bumps and jars of handling, which it may experience as railway traffic. A valuable field of investigation and scientific study of the construction and materials of packages is opened by the new machine, such as best methods of interior and exterior packing for fragile or irregular shaped objects; the determination of proper specifications for containers carrying various commodities, and similar useful hints.

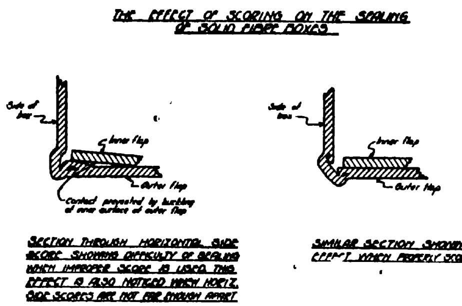


TYPES OF THREE-PIECE CORRUGATED BOXES, showing (a) the double cover; (b) double lined flap; (c) double lined slide; and (d) three-piece folder.

Experiments in this direction have revealed that the sealing of the flaps of the solid or corrugated board container requires special attention. The flaps of the box are generally constructed to fold one over the other, and the sealing process is done either by hand or by the sealing press. Various kinds of adhesives are being used, but general opinion is in favour of silicate of soda. The ad-

hesive used and the method of application however, have not proved as important to the "life" or resistance of the container as the principle of contact between the inner and outer flaps.

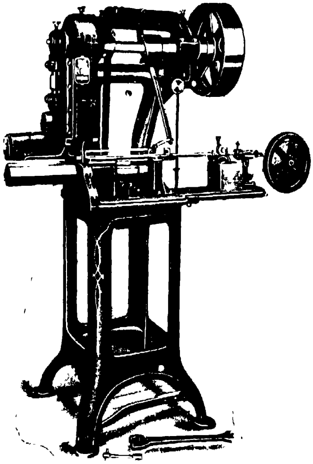
It has been found in a test given to 1,000 filled and sealed solid and corrugated board boxes of various shapes and sizes that many of the inner flaps, when opened, revealed unadhered portions with a smooth glassy appearance, and that surface tension had bent the board through absence of contact with the outer flap. In order to seal a box properly, it is necessary to bring the flaps into intimate contact throughout their entire area. While this also sounds obvious, it often necessitates considerable study, both by the box maker and by the box sealer. Once this is accomplished, the question of the brand of adhesive and of the pressure and setting time assume relatively minor importance.



SEALING, showing the effect on a packing case when the board is scored wrongly.

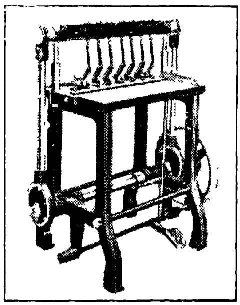
One form of bad flap contact may be due to poor creasing, such as when the creasing knives are not set to proper measure and the sides of the box are not far enough apart for the flap. This is a difficult evil to see, as the

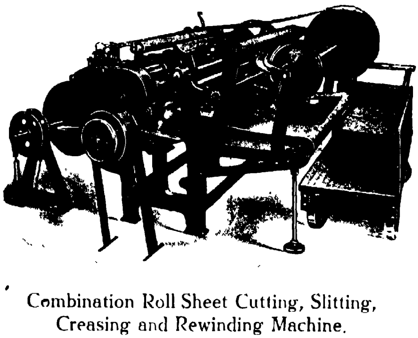
Types of Staying, Slotting and Cutting Machines



Heavy Pattern Corner Staying Machine.

Partition Slotting Machine

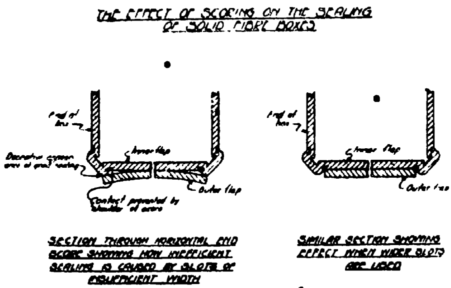




Combination Roll Sheet Cutting, Slitting, Creasing and Rewinding Machine.

outer appearance of the box gives no indication that contact is absent.

A more frequent offender is the box having high "shoulders" at the crease and lots of insufficient width to clear these shoulders. When this box is sealed, the outward appearance is good, since there is contact between the outer flap and the tip of this shoulder. After railway traffic, however, a small amount of handling often opens the flap, revealing the fact that contact was entirely missing over most of the remaining area.



SEALING, showing the effect on a packing case through insufficient width of the slots.

This condition is avoided in most boxes by cutting a wider slot. The shoulders still remain, however, and properly so, as they are usually evidence of an efficient box corner. These shoulders may even extend beyond the thickness of the outer flap. If such a box is sealed in the ordinary manner, these shoulders will prevent good contact. The remedy is to slip a rectangular piece of wood or fibreboard under the box at the time of sealing. This board should be cut in such a way that it just fits inside the four shoulders.

One of the chief enemies of contact is the occasional warping of fibreboard. This product is often made under

different atmospheric conditions than those prevailing in the packing department. A bundle of fibreboard boxes should not be opened until they are ready to be packed. This is the surest way to avoid warping. If the bundle has been opened for some time under extreme atmospheric conditions, the flaps may have become warped. A little study on the packer's part at this point will well repay the effort, as he can quickly devise a simple system of cleats or pads so placed that the warp is corrected and contact can then easily be secured.

After testing it was found that corrugated boxes could be sealed to set quickly and efficiently when only a thin film of adhesive and moderate pressures were used. Solid fibreboard boxes required more pressure to flatten out any possible warped or uneven areas. When a sealing press is not available, a substitute for this extra pressure consists in the use of more adhesive. This excess of adhesive tends to soften the board and thus increases the contact and the efficiency of the joint. Added strength can always be given to the adhesive-sealed container by the use of sealing tape.

The collapsible box series are now completed, and the next class of box to be described will be the most recent of all, the round box of both cylindrical and conical shapes.

§ 7

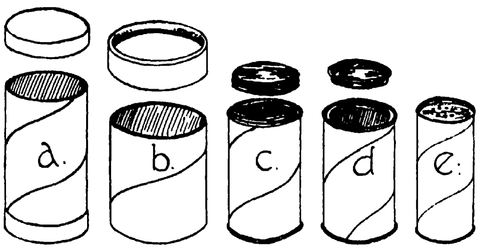
THE ROUND BOX.

One of the most recent forms of cardboard package, but emanating from that much older product, the paper tube, is the round box. The paper tube, originally and still used for postal service and as a core for rolls of paper or cloth, gave rise to the idea that it can be cut to varying lengths, fitted with a cap on top and bottom, and thus adapted to hold different commodities of domestic or commercial value. Particularly as a container for foodstuffs of a powdered and semi-liquid nature, this form of package has received general recognition and become as established as any other kind of cardboard receptacle.

Varied requirements have impelled inventors to devise different forms of this style of container. From the original cylindrical tube fitted with detachable (slip-on) lids for top and bottom, there has been evolved a container with an inverted bottom forced up into the tube and fixed there, for which a slip-on cover is used; another with a shoulder or neck to the tube body so that the cover fits flush with it; and the fourth variety, the composite container in which the tube body is fitted with a metal top and bottom. All these are cylindrical in shape. In a different category are the conical paper containers with seamed board bottoms and pressed-in flat board lids, which are used to so considerable an extent as packages for cream, honey and similarly viscous foodstuffs. Still other varieties are the oval-shaped container with metal top and bottom, and the all-paper container, the top and bottom of which, each

pressed or moulded out of a sheet of board, form the entire package.

Further variety has been given to the manufacture of the cylindrical container in the formation of the tubular body, which may be straight wound or spirally wound. After this tube has been formed by either process it is cut to desired lengths, and each is fitted with either board or metal top and bottom. The conical container is prepared from a specially shaped strip of board and lap wound round a conical metal former, after which the bottom is seamed in and a groove fitted for the flat cover in one operation. The oval composite container is made on the straight wound principle. Reference must also be made in this section to the moulded box, though this can be made in other shapes than round, and by two processes : one by moulding wet pulp into the desired shape; and the other by pressing out the container from one piece of board.



Types of Spirally Wound Boxes, showing (*a*) with slip-on lid and bottom; (*b*) with punched out and seamed slip-on lids; (*c*) with metal screw-on lid; (*d*) with metal detachable lid; and (*e*) with perforated metal lid.

The Straight Wound Tube.

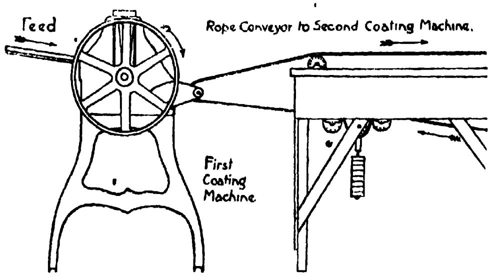
There are two ways of making a straight wound tube. For the earlier method, a sheet of thin cardboard, from 3 to 4 feet in width and of a predetermined length, is glued on one side and wound straight on to a revolving mandrel

about 5 feet long. As the cardboard is wound on the mandrel the succeeding layers adhere to one another, forming the tube, the length of which is equal to the width of the original sheet. The number of layers in the tube, usually about four, depend on the length of cardboard taken and the diameter of the mandrel. If the tubular body is required to contain foodstuffs which must not be contaminated by the board or allowed to penetrate it, the sheets are previously coated with paraffin wax or a similar substance, which renders them waterproof and impervious to the contents. A description of various proofing materials will be found on p. 195.

Each sheet of board is passed through a coating machine, which has an automatic feed that will send the sheets to the waxing rollers at a very fast speed. It is adjustable to any size, up to 52 inches in the largest machine, and so that the sheet can be placed in any position on the machine; or, if required, a series of parallel uncoated strips can be had by adding the necessary equipment. There is no difficulty in regulating the amount of wax on the roll, a thin or thick coating being applicable without the other side of the sheet being touched. Some coating machines are provided with a reservoir supply, having a "constant level" tank, in which a large supply of wax cakes is placed and, when melted, fed to the roller tank at the required temperature. This machine will leave an uncoated margin up to 2 inches wide at the end of each sheet to permit of glueing or pasting, as the waxed surface will not take adhesive.

If the tube does not require to be coated with paraffin wax it is first passed through the sheet glueing machine, which coats each sheet with adhesive preparatory to its being rolled into a tube. By means of the open housing which carries the upper pressure roll, the sheet may be passed through the machine so that the width between the side gauge and the rolls is uncoated. This portion of the sheet forms the first lap of the tube as it is wound around the mandrel. The adhesive is applied in a heavy

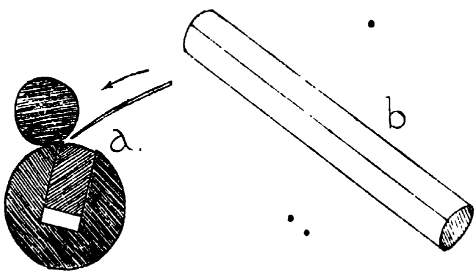
or a light coat, which is easily regulated by adjusting the "doctor roll." For varying thicknesses of material, the space between the pressure and coating rolls is adjusted by means of two hand wheels. As each bottom sheet fed from the stack is glued it is removed and placed in a tempering rack, which makes the sheet "tacky," and is then ready for rolling.



SHEET COATING, showing how two coating machines are placed at a sufficient distance apart to enable the sheet to dry after the first coating while being taken along the rope conveyor to the second machine.

The tube rolling machine has a collapsible mandrel, a section of which grips the glued sheet and then winds it into a tube. A calendar roll guides the sheet into the mandrel clamp and forces each ply firmly into place under great pressure, making perfect adhesion. By releasing the pressure on the treadle, the clamping section releases its grip on the tube which may be readily removed. This machine is equipped with a cutter bar and knives, so that it can be used for cutting to the required lengths as well as for rolling. Rolling mandrels are more expensive than plain cutting mandrels, and, in order to save the rolling mandrels from possible damage through carelessness on the part of the operator a separate cutting mandrel for each size rolling mandrel should be obtained.

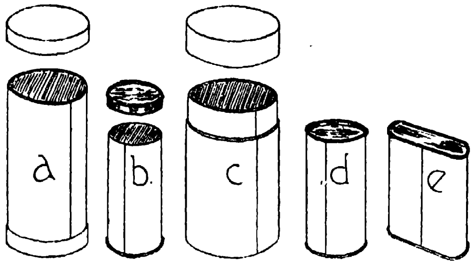
As the output from a rolling machine can be from three to five thousand tubes in ten hours, full length of the mandrel, on work of three to four ply and 2 to 4 inches in diameter, for such a large output it is necessary to instal a separate tube cutting machine. When operating this machine the mandrel is allowed to rotate continuously and the tubes are slipped on until they are tight; the foot treadle is then depressed, bringing the outer bearing up into supporting position, simultaneously advancing the knives to cut and trim the tube. The foot treadle is released, the knives move back, the supporting bearing swings down out of the way, and the operator slides the cut and trimmed tubes off the mandrel into a conveyor or basket.



Tube Rolling, showing (*a*) sectional view of the sheet just before being gripped by the clamp of the collapsing mandrel and prior to rolling; and (*b*) the finished straight wound tube.

In the more modern method of straight wound tube making, a continuous strip of heavy paper or thin board, just as wide as the tube body is to be long, is taken from the reel, and while on its way to the revolving mandrel is coated with an adhesive on what will be the outside of the strip. After three to five layers have been wound in the mandrel, making a three, four or five-ply body, a guillotine attachment automatically severs the strip, and the

tube thus formed is pushed along the mandrel to make room for the next. The first tube is simultaneously made firm by a roller, and when this operation is completed it is brought into a further position where, if desired, it will pick a label which will be wrapped round it.

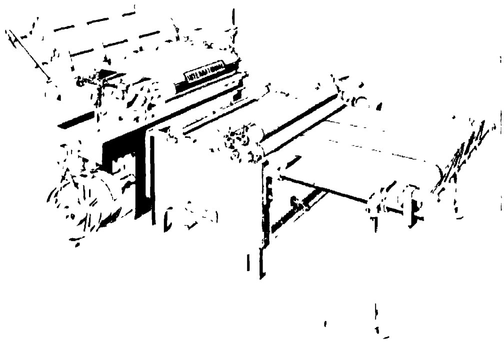


TYPES OF STRAIGHT WOUND BOXES, showing (*a*) with slip-on lid and bottom; (*b*) with metal slip-on lid and seamed bottom; (*c*) with shoulder for slip-on lid; (*d*) and (*e*) with seamed metal lid and bottom; and (*f*) the oval shaped container.

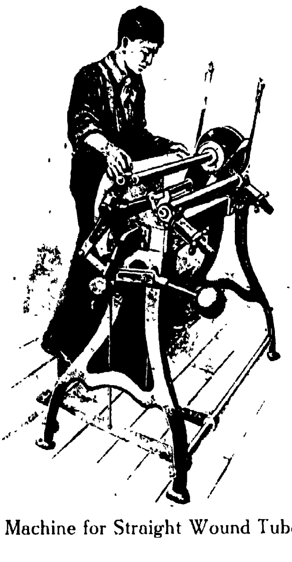
If it be desired to make a smooth lap on the tube, or on the edge of a cover, to permit of flush labelling on the outside or close fitting on the inside, there is a skivering machine, which is used to level the edge of the board. The machine feeds the board at the rate of 25 feet per minute to the skivering wheel, which skives from ⅛th to 1 inch in width, as desired, leaving a flat, smooth surface which readily adheres without curling. A special feature of this machine is the exhaust fan mounted under the machine, and connected with a hood surrounding the skivering wheel. The dust from the work is thus carried away and the air and the machine kept clear.

A similar process by a different machine produces what has been termed the paper barrel. This machine takes paper from the roll and winds it round a mandrel of the

Types of Coating and Tube Rolling Machines.



Paraffin Wax Sheet Coating Machine.



Rolling Machine for Straight Wound Tubes.

required diameter. The paper is glued as it is wound and a very solid and compact container is the result.

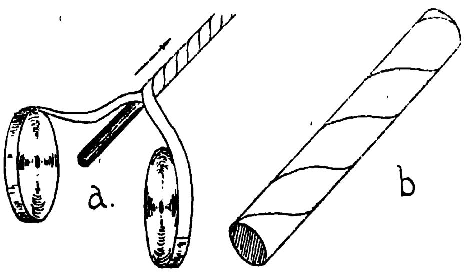
THE SPIRALLY WOUND TUBE.

Thin greyboard or strawboard of a caliper from .005 to .040 inches in reels is used for making the spirally wound tube. The reels are first cut in narrow widths on the slitting and re-winding machine, each coil being from 2 to 4 inches wide. For a two-ply tube, one of these narrow reels is fed on to a fixed mandrel in the spiral tube winding machine at a carefully adjusted angle. Driving belts are arranged suitably to encircle the mandrel, and as they grip the cardboard strip it is drawn on, passed round and along the mandrel in a screw motion. To hold the tube together a second narrow reel of board is fed similarly and simultaneously into the machine from the opposite side, so that one layer is wound round the other while it is on the mandrel.

The angles of feed and relative positions on the mandrel of these strips are matters requiring considerable attention, as it is essential, to obtain strength and firmness, that the edges of the first layer fall in the middle of the second. Moreover, butt joints which fit exactly between the contiguous edges of each strip are aimed at to give neater finish and add to the strength. The two layers are stuck together by a high grade glue if a food container is required, but cheaper grades can be used for the round boxes required for such articles as soap powders. The glue is applied to the outer surface of the first layer or the under surface of the second by the strip passing over a drum which revolves in a hot glue bath.

The moisture-proofing, which is generally done with paraffin wax, is performed on one of the reels before it passes to the tube-winding mandrel. As with the other reel which receives the glue, this web of board passes over a drum that revolves in the hot paraffin wax bath. The driving belts which form the tube round the mandrel force the coating of wax into the board right up to the glued surface of the

other web of board, this being due to the pressure of the belts and the degree of heat given to the mandrel by a steam-applying device at its head. The number of layers (reels) may be increased to three or more if greater strength and rigidity are required. Usually a thicker board (.020 to .080 inch caliper) is adopted than for a straight wound tube, but with thinner material the edges may be allowed to over-lap without being unsightly.



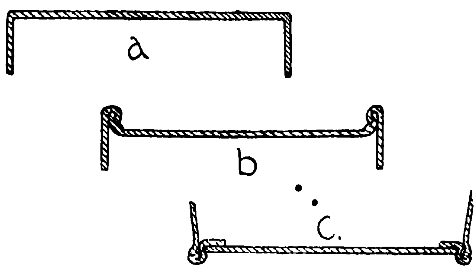
TUBE WINDING, showing (a) how the roll is wound for two-ply tube making; and (b) the finished tube.

In this operation the glueing is of most importance, as great care must be given to both the consistency and temperature of the bath and to the speed of travel for the glued layers so that the adhesive is of the right degree of tackiness. The driving belts must be adjusted so that the adhesion is just enough to overcome the friction between the inner layer and the mandrel, otherwise the pull of the belts will prevent the tube from travelling forward. Given satisfactory conditions, a continuous spiral tube leaves the mandrel and is sawn off into 3 or 4 feet lengths. Up to 60 linear feet per minute can be obtained from one of these machines. After the lengths of tube are seasoned they are cut to the required sizes for the containers on the tube cutting machine. As for straight wound tubes it may be also desired to wind a white or tinted lining paper round the

outside of the tube, and this can be done on the tube winding machine by means of another narrow reel.

TOPPING AND BOTTOMING WITH BOARD.

If the containers are to be closed with cardboard caps at top and bottom, reels of board are first slit and rewound to the width required, that is to say $8\frac{1}{2}$ inches wide for a maximum diameter for the cap of $2\frac{5}{8}$ inches, leaving $\frac{1}{8}$-inch for the trim and $\frac{3}{8}$-inch for the flange. The diameter of the cap and the depth of the flange can, of course, be increased or varied according to the requirements. When the narrow reel is ready it should be run through a moistening machine, which treats it with a solution of soap and water and rewinds it ready for the press which makes the caps.



BOARD COVER MAKING, showing sectional views of (*a*) a pressed-out slip-on lid; (*b*) a punched-out and seamed slip-on lid; and (*c*) a disc bottom.

This press is known as a double action paper cap or round box cover press, the reel or ribbon of board being placed into position, after which the machine automatically feeds it, cuts the blank and forms up the sides of the cover. The feed of the roll is intermittent, and during the upstroke of the press head the paper strip is automatically moved forward to a position ready for the next downward stroke. This press cuts the blank and forms the cap at

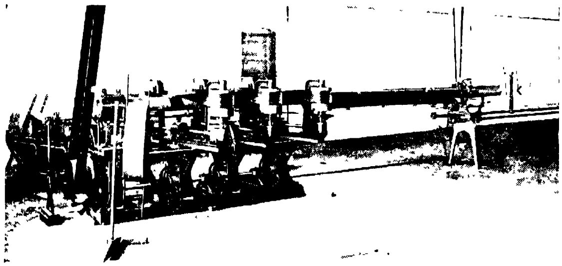
each stroke of the machine, which comprises the double action.

The reciprocating head has an outer slide which carries the cutting die and an inner slide or plunger for forming the cap. These slides are so timed that the blank is first cut and then formed into a cap. The finished caps drop into a receptacle and the waste passed through the press. It is fitted with a treadle, which may be locked down for continuous running or tripped for each stroke, and the output is about 100 to 120 per minute according to the size of the cap. Tin caps can also be made on this press, but require different die sets, and the material must be hand fed.

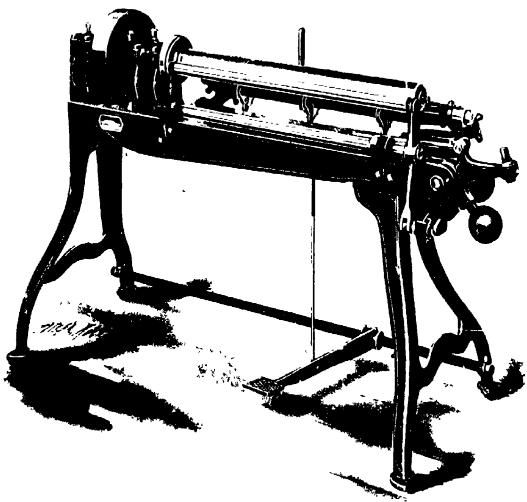
There is also a machine which will turn in a cardboard disc over the bottom of a tube to make a non-leakable joint, known as the inner roll bottoming machine. These bottoms are punched out and spun or beaded over, and may also be used for detachable caps. There is also a spinning press made for inserting a groove inside the tube, into which a plain disc of board is pressed as the cover for top or bottom instead of it being closed with a flanged cap. A different forming tool is required for each diameter of tube to be " spun," and these tools are made specially to meet requirements and are usually gas heated.

For certain semi-liquid contents, two special kinds of lid or closure have been devised for the cylindrical container. One of these refers to a cardboard lid or disc and is based on the principle of the container which has a metal rim with an inward projecting flange to form a definite seating for the closing disc. In cardboard containers for liquids the usual form of moulded rim has an annular groove for receiving the closing disc, the lower surface of the groove projecting slightly beyond the upper surface to check the descent of the closing disc when it is sprung into the groove; while this closure may be satisfactory for containers of the nature of bottles which are supposed to be carried in upright position, it is not adopted for the handling to which containers of the above kind are subjected.

Types of Tube Winding and Cutting Machines.

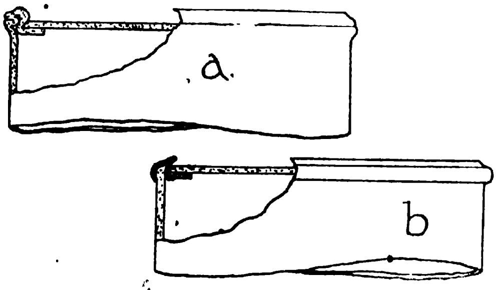


Spiral Tube Winding Machine.



Tube Cutting Machine.

The rim is moulded with an inwardly projecting flange similar to that of the metal rim, and preferably with an overhanging upper edge to form a recess into which the disc is sprung.



Board Cover Making, showing part sectional views of (*a*) a board lid and (*b*) a board lid with a metal rim.

The other method of closure adopts the metal rim, with which it is possible to avoid the mutilation of the closing disc upon opening. To avoid mutilation the container is generally made with a metal ring seamed or spun on to the cardboard at the mouth and having an inwardly turned flange flat on its upper surface on which the disc of cardboard or the like is seated. For retaining the disc in place the ring is so shaped that there is a conical part above the flange, which part is of slightly larger diameter at the upper part of the ring in use. Thus when the disc is pressed on to the flange it wedges itself into the part of smaller diameter. The disc is easily removed by a pointed instrument without appreciable mutilation, but the closure is not adapted to withstand rough handling of the charged container. It is, of course, possible to vary the styles of these disc closures, so long as the styles and materials lend themselves readily to easy adjustment.

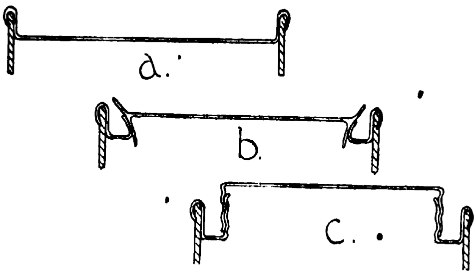
TOPPING AND BOTTOMING WITH TIN.

Important strides have been made during and since the European War with the composite container as a food package, this container being made with tin tops and bottoms and tubular board bodies. The bottoms are invariably crimped or seamed on to the tube, and the tops are varied in style, some being of the cap kind, as in cardboard, and others having crimped edges with a removable lever-lid or a screwed-on lid, or a flat or domed crimped cover perforated to allow for sprinkling of the contents. For making the tin caps there is a single action inclinable press which blanks out and beads the sheet of metal, or the machine may be fitted with a roll feed attachment if desired.

The principal form of attaching tin covers to the composite container, however, is by crimping or seaming the metal of the cover to the board of the tube. When a metal end is attached to a metal body, the flange of the former is folded over and under the flange on the latter, and these folded flanges are then pressed flat against the tube body, making a double seam. For this operation a crimping machine is obtainable. It has a capacity of 800 to 1,000 per hour, and the table on which the tubular body is placed is lowered by foot treadle and raised to operating position by a counter spring. The crimping roller is mounted on an adjustable carriage and will accommodate any container up to 8 inches in diameter. A chuck is required for each size.

Another machine performs the seaming operation with two rollers, and, in order to obtain uniformity, the first operation roller sweeps past the seam before the second operation roller can come into play. The movement of the latter roller is determined by a stop which is a very necessary provision in composite container work. This machine is also readily adjustable for different sizes. One of the most modern appliances for this seaming operation is an automatic double seaming machine which fixes the

metal caps at both ends. The box parts are assembled in preparation for seaming and are fed by a mezzanine plate. This machine stops if any process is inaccurate, rejects defective parts, and can be changed quickly for different sizes. It has an output of 56 boxes per minute.

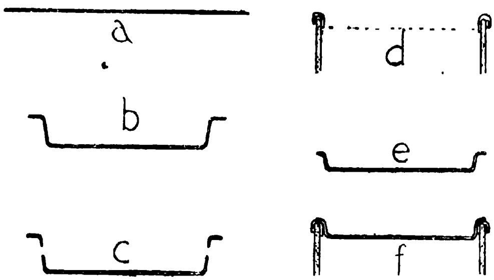


METAL COVER MAKING, showing sectional views of (a) a closed lid; (b) a lever lid; and (c) a screw-on lid.

This method of closure for composite containers is sufficient without further treatment if dry materials are to be contained in them, but when the containers are required to hold liquids the tendency to leakage at the seam is overcome by the use of a so-called seaming solution. This solution may be applied either to the flange of the metal end by painting, or to the body by standing in a shallow dish containing a small quantity of the solution. Mixtures of starch with casein solutions generally give satisfactory results. Rubber solutions, or extremely thin rubber washers, were formerly in favour, but are now superseded, the former by the above or some special preparation, and the latter by specially prepared paper.

Several kinds of detachable metal lids have also been invented, such as those with a cylindrical collar soldered over an opening in the crimped lid, into which a cork or other stopper is fitted; the stud-hole top, which is soldered

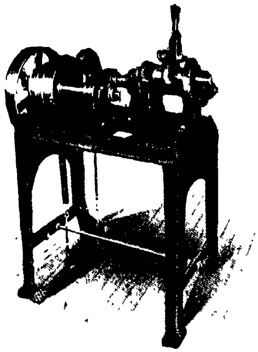
down into the crimped lid after filling; and the "household closure," in which inverted caps, stamped out to fit the opening in the crimped lid, are sealed leak-proof by expanding the body of the cap with a special tool. The most popular of all is the screw cap lid, because it dispenses with soldering altogether and is metal throughout. For this operation a thread rolling machine threads sheet metal screws and caps, and it is possible in many cases to thread the cap and the screw on which it fits at the same time, thus doubling the output, which is generally of about thirty pieces per minute according to the skill of the operator.

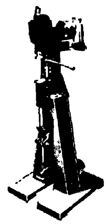


METAL COVER MAKING, showing sectional views of (*a*) a circular sheet of metal; (*b*) the shallow cup formation; (*c*) the cup walls cut; (*d*) the upper portion of (*c*) seamed to the tube; (*e*) the lower portion of (*c*) flanged; and (*f*) the lid fitted.

There is also a patented method of making a lever lid, and the flange or lip upon which it rests, from one piece of metal. A circular blank is stamped into a shallow cup form with an outward flange, and the wall of this is cut horizontally, the upper portion serving for the rim or lip and the lower for the lid. The upper portion is seamed to the tubular body, and the lower portion is flanged to rest upon and inside the lip portion.

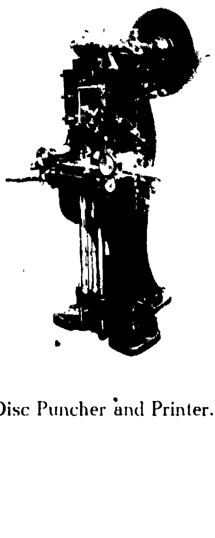
Types of Board and Metal End Making Machines





Crimping
Machine.

Threading Machine for
Round Box Metal Lids.



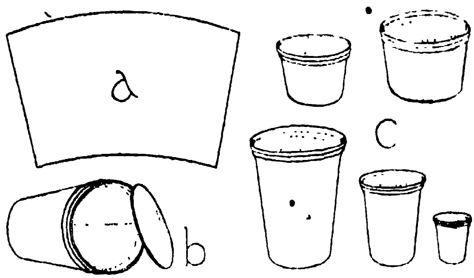
Disc Puncher and Printer.

Tin End Seamer.

An excellent lid is obtained this way, and also economy in metal.

MAKING CONICAL CONTAINERS.

As described previously, shaped pieces of board are required for conical boxes. One end of this blank is narrower than the other, and that for the top of the box is cut to convex form, while the bottom is concave. When this blank is lap wound it forms a conical tube, and this is inserted into the chuck of another machine, with the flanged bottom disc inserted roughly in the narrow end, the flange towards the bottom. By depressing a foot pedal, a sliding headstock carries a tapered plunger against the bottom, and rollers fix it in position.



CONICAL BOXES showing (a) the blank; (b) a finished box, with disc lid; and (c) types of filled tube-shaped and other conical boxes

In the operation, the end of the tube is flanged by rollers and brought into contact with the flange of the bottom disc. The next process is to finish the flanges by pressing both inwards to secure them together. When the flange is closed a beading is formed, and the bottom end is secure. Then the finished box body is placed in a waterproofing bath of paraffin wax, if the contents are to be of a liquid or fatty nature. In one type of machine

the top end of the body is also widened slightly and beaded so that a disc can be inserted to close the container.

The decoration of this conical box is generally done before impregnation with the wax or other waterproofing substance, and before the shaped piece forming the wall is lap wound. When complete these boxes are suitable for containing such varied products as honey, syrup, preserves, jelly, lemon curd, custard and other powder, malt extract, cocoa, dried eggs, waterglass, etc., for an indefinite time, while milk, cream and other fatty substances may be contained in them for a limited period. These containers are made in varying sizes from $\frac{7}{8}$ths of an ounce to 8 lbs., and can be made in either lengthy or tub-like shapes.

FINISHING THE ROUND BOX.

Because of the glazed surface caused after proofing the printing must be done first. Great care must be taken in the colours used, so that they should not run or mix when the coating fluid is applied. Several prominent ink manufacturers have given this question serious attention in their laboratories, and much valuable experience has already been gained in this direction. The alternative method of round box decoration is that of labelling, and here again some difficulty exists, because a waxed surface does not enable the ordinary adhesive to be applied satisfactorily.

A special adhesive has been invented by a British firm who supply it in conjunction with a round box labelling machine. This will handle any round container, either with or without lids attached, and does not require a skilled operator or much driving power. In operation the labels of wrappers are picked up automatically from the pile on the feeding table. One end of the label is first securely fixed to the container by the special adhesive, and the label is then drawn round tightly, after which the other end is pasted down on top of the first.

The application of the adhesive is clean and as only a small quantity is used the containers can be packed right

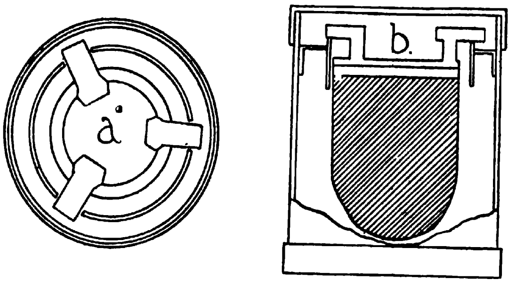
away for delivery without any waiting for the labels to dry. Moreover, as the labels are not covered with adhesive over their whole surface they look brighter and cleaner, and there is no superfluous adhesive to be spread on the face of the label. The output of this machine depends on the size of the containers, but from 2,000 to 5,000 may be wrapped on it per hour.

In another form of round box labelling machine the packages are fed on a conveyor. A label gripper control registers the label, the unprinted side of which is covered with a thin film of adhesive, so that the label is registered accurately on the can. The cans are held securely in position during the labelling and a brushing arrangement at the outlet gives a final rubbing effect thereby tightly sealing the packages. The capacity of this machine is about 30 a minute, one attendant only being required.

Sometimes the round box has to be fitted inside with cardboard lugs and sleeves to contain special articles, such as electric bulbs. There is an extensive use for this product, and also for containing incandescent gas mantles, and a box of this type will now be described. To hold inverted gas mantles, projections are fitted inside the tubular body in the shape of a sleeve, which corresponds in length to the depth of the mantle ring and its lugs. The diameter of the sleeve which is fixed to and centrally within the box is such, that when the mantle is placed in it, the lugs of the mantle ring rest on the top of the sleeve, the fabric of the mantle attached to the mantle ring when placed into the box being below the sleeve.

The sleeve is provided at its upper end with cut-away portions or notches into which the lugs of the mantle ring fit. This allows of the mantle being placed directly on to the burner without first having to be removed from the box. All that is required being, after the removal of the lid, to raise the box to the burner till the lugs of the mantle ring engage with the notches of the nozzle on the burner, then slightly to turn the box and lower same, leaving the mantle on the burner.

When round boxes were first used for containing foodstuffs one of the objections to their more general use was that they were too fragile for transit as goods traffic by railway or ship. This objection has been overcome by the production of packing cases made of cardboard, sometimes reinforced with wood, and fitted with cardboard trays, which have been proved quite serviceable for this purpose.* One of the most popular kinds of these packing cases is known as the fibreboard packing case with wooden frame ends, and it will hold 86 1 lb. jam or syrup containers.

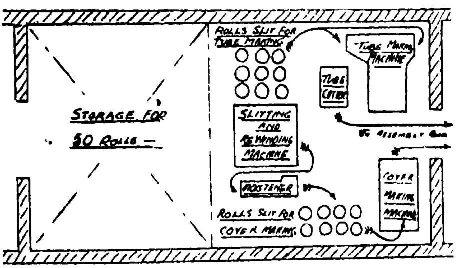


ROUND BOXES FOR GAS MANTLES, showing sectional views of (*a*) a bird's-eye view of the interior with the projections on which the mantle lugs rest; and (*b*) an elevational view of the same container.

This case has two trays, each holding 18 containers, and a sheet of fibreboard is placed between the two layers of containers. When ready for closing, another sheet of board is placed on the top of the containers. The trays are easy to lift out by means of the tape bands attached. It is stated that a case like this was packed with 86 lbs. of marmalade, and shipped from London to New York as ordinary freight. It was opened by the Customs and not properly re-fastened, and then closed again for return. Though the total journey was over 6,000 miles, the case arrived in good condition with the marmalade intact.

* See pages 85 and 86.

For other trades this case can be used for packing a number of other boxes. In connection with this form of packing, there has been produced what is known as the one-piece combined box and tray. This tray, which is an ordinary folding box, is light and cheap, easily put together and packed. It affords an effective and economical means of advertising, and makes an attractive box ready to be set on the grocer's counter immediately after being taken from the packing case.



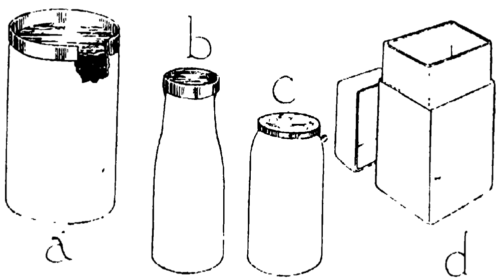
ROUND BOX MAKING, showing plan of small plant for making cylindrical containers.

Another of the transit containers is known as the fibreboard one-piece case, and can also be fitted with fibreboard trays. The flaps are glued down and the joints covered with adhesive paper tape, making the case proof against pilferage. A third variety is the corrugated board case, which has proved invaluable for the sending of bottles by rail or sea. It is strong, tough and resilient, standing wear and tear, and absorbs shocks without breaking open. All of these cases can be made waterproof, if required.

BOXES MOULDED FROM PULP.

Reference has been made at the beginning of this section to boxes which are either moulded or stamped out in one operation, and though not only round but rectan-

gular boxes can be produced in these ways by the methods adopted the results are, perhaps, more allied to the round boxes which have just been described than to any other variety of machine made container. One of these methods involves the moulding of the box direct from ground wood or waste paper pulp. By the other method, the box body is moulded from a shaped piece of cardboard.



Boxes Moulded from Pulp, showing (*a*) a cylindrical box with broken section; (*b*) a milk bottle; (*c*) a shaped preserves container; and (*d*) a telescope cover shoulder box.

For the pulp-moulded box an automatic machine is used. The pulp is impregnated with a material which tends to make it impervious to moisture, and this material is introduced into the beater grinding the pulp. This pulp is then introduced into a vat in the automatic machine from which it drops into a mould of the shape of the box. This mould is subject to superheated air or steam of 600° F., and thereby sterilizes the finished container. From thirty to sixty seconds are required for the pulp to remain in the mould, after which the finished seamless box drops on to a delivery table.

Any number of these machines may be installed in a line, and each unit may be for a different size and shape

of box. Each unit, on the basis of two containers a minute, will produce nearly 10,000 containers in eight hours, with a ten-unit plant, and as the machine is entirely automatic it can be run independently of a daily operative. The cost per 1,000 containers, each to weigh about 1¼ ozs., (requiring a ton of dry wood pulp for 21,338) will average at a total cost for material of about 3s.

Boxes Moulded from Board.

The method employed for this kind of box may also be termed moulding since it is similar to that of die sinking, an ordinary die press being usable for the work, but a special stamping or moulding tool with a correspondingly recessed mould is necessary. It is preferable, because of the great pressure required in the moulding operation, that a good quality paperboard or pulpboard is used for these boxes, but excellent results have been obtained with strawboard, and as more experience is gained there is every likelihood of obtaining a successful box from even the most brittle raw material.

So far the presses used for this method, which is comparatively of recent invention, have been hand driven, and consequently only small boxes have been successfully produced. With a hand press it is possible to mould boxes up to 2½ inches in diameter and 1 inch in depth, but experiments are now being made with power presses for this work, and when they prove satisfactory it should be possible to manufacture boxes of much larger size, such as are used to contain chocolates, cake, and similar articles. There is, however, a wide field of use for the smaller sized boxes as containers for chemists' and druggists' specialities, such as pills, powders, ointments, etc., as well as for numerous other articles of private and public use.

An important advantage about this process over practically every other method of box making is that, given sufficient variety of stamping tools and moulds, the one press will produce any shape of box within the limits

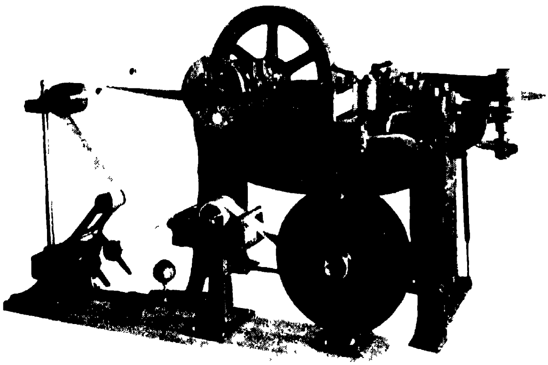
of its size. Furthermore, as with the folding box or carton, it is possible to print the board to be used with any design or lettering, or to cover the board with a suitable lining paper, before the moulding process, so that the finished box, ready for packing, is thus obtainable in one operation. The speed of production for a hand press is, of course, dependent on the skill of the operator, and, in the case of a power press, upon its automatic qualities.

THE METHOD OF OPERATION.

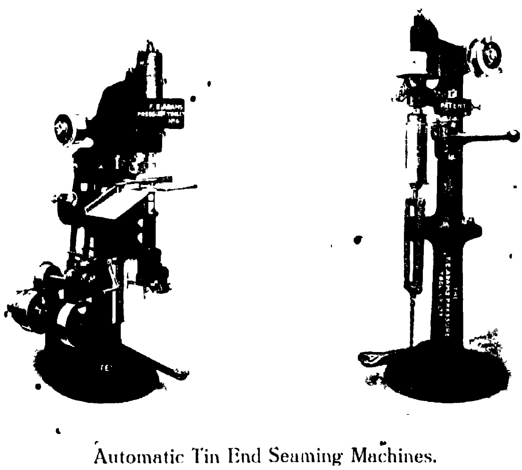
Each moulded box is comprised of two parts, the box body and the slip-on lid. For making both parts the operation is similar, the only difference being that the mould required for the lid should be slightly larger than that for the box body. Similarly, the size of the board blank for the latter should be correspondingly smaller than that for the former. This board blank is cut out in one operation on a punching-out press, several layers at a time. The punching machine is made in several sizes, from the hand lever type to the heavy double-geared pattern for power. In construction this machine is built to operate similarly to a moulding, doming or die-sinking press in so far as the punching or cutting operation is performed by a downward movement of a flat impression head.

For punching out small sized discs the hand punching machine will be found satisfactory, and of the two kinds made one has a knee lever action, which gives a high pressure with a minimum of effort, and the other has a screw action like a copying-book press. The next type is made for treadle or power and for punching out from medium to large sizes. It is operated through a covered gear by two cams and the top bed is allowed to run continuously. The work to be cut is put on a sliding tray and the punch or cutter being placed on top, the tray is then slid into the machine, the impression head comes down and forces the punch through the board and the tray is withdrawn as the head rises.

Types of Cap Drawing and Seaming Machines.

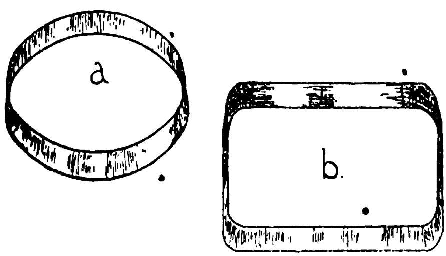


Cap (Round Box Lid) Drawing Press.



Automatic Tin End Seaming Machines.

There is also a heavy power punching machine operating through four pillar rods, and having a wider platen than usually made, of 40 by 16 inches. The double gear and heavy fly-wheel provide ample power for cutting through large thicknesses of material with the largest punches. For a round box, the blank is round, with a

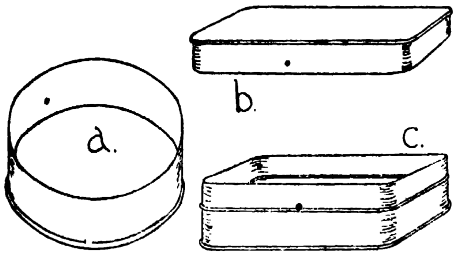


Board Moulded Boxes, showing steel punches for punching out of cardboard sheets the discs for making (*a*) round; and (*b*) oblong boxes.

diameter corresponding to the combined outside depth and diameter of the box body or lid. If the box is to be oval, square, or oblong, the blank is cut in similar shape, but it must be remembered that the square and oblong boxes have rounded corners, and that the corners of the blank must also be rounded.

When the cardboard disc is cut to size, it is placed in a groove on the recessed mould of the moulding press; the press is then turned to lower the plunger with the stamping tool, which enters the mould driving the cardboard disc into it and pressing it into the shape of the mould. It is upon the shape and formation of the moulding tool and the mould that the success of the operation depends. For a round box the mould has at its centre a cylindrical passage, both ends of which are curved outwardly. The middle portion is cylindrical, forming an annular groove of

a diameter equal to an outside diameter of the box. Above the cylindrical passage is the groove into which the disc is placed, and of a height and diameter to take the disc exactly. This mould rests in a bed plate similar to that fitted on die-presses of any known type.



BOARD MOULDED BOXES, showing (*a*) a round box body with one bottom flange; (*b*) an oblong box lid; and (*c*) an oblong box body with two flanges or beadings.

The stamping or moulding tool comprises a cylinder, the tail-piece of which is fixed on the press, and a piston held in the cylinder by screws. Two curved spring discs are fixed in contrary directions between the bottom of the cylinder and the top of the piston, and press the piston downwards. The cylinder and the piston continue their descending movement until the piston stops, when the bottom of the box touches the bed plate of the mould, and the cylinder still presses downwards on the edge of the cardboard, forcing the latter to extend into the inward grooves of the mould to make the flange or flanges. The box is then finished and, as the stamping tool rises, the mould is raised or lifted out of the bed plate and the box extracted. With this process it is possible to mould a box with a flange or beading on its side to form a shoulder upon which the lid can rest, and also to dome either the lid or the bottom of the box by shaping the stamping tool and mould accordingly.

ANOTHER METHOD OF OPERATION.

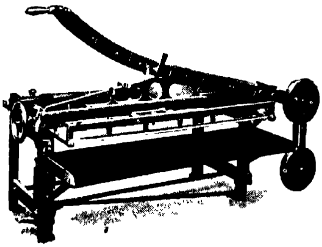
Somewhat more attractively finished boxes, suitable for high-class perfumery and toilet powders, are made from four pieces of board in either round, oval or round-edged square shape. For these boxes a special series of machines are obtainable, as follows : a glueing machine to apply adhesive to the sheet of paper or thin board from which the tubes are made; a rolling machine to form the tube; a cutting machine to separate the tube into rims or sides of the box to the required depth; a hand lever press for cutting out the top and bottom discs of board and of covering paper, or an eccenter press for speedier work on the board discs; and a fly or a friction press for the finishing of the box.

After the rims are cut to size, allowance having been made for the small turn-over and flanged portion at top and bottom, a disc which has been previously domed on the fly or friction press is inserted inside near the top of the rim, the whole of which fits into the dies for forming the flange and pressing the disc firmly into the rim. As the head of the press descends it flattens the domed disc and presses its edges into the rim which accordingly develops an outward flange to receive the disc. The continued pressure folds the top of the rim over the disc and the closure is complete. As the head rises a printed or otherwise decorated and glued paper disc is laid over the top and a second pressure finishes what is either the lid or bottom of the box. As most of these boxes are of the telescope or slip-on lid variety, a shoulder or neck can be inserted for this purpose. If domed boxes are required it is only necessary to make a deeper doming of the disc in the first instance, the shape of the dies will account for the rest.

With this kind of container, the description of the varieties of machine made boxes is ended. To complete the whole range of boxes, it is necessary to include the special designs which require manufacture by hand. In

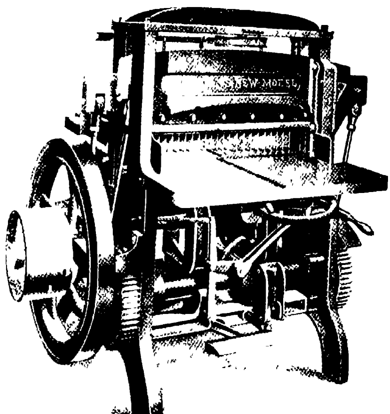
nearly every case for what is known as a hand made box many of the introductory operations are performed with the assistance of mechanical devices, and the production by handwork is mainly associated with the assembling of the various portions to make the box and with its decoration. The following pages will deal with this group.

Types of Cutting and Bronzing Machines.



50 in. Hand Shears.

Automatic Self Clamp Guillotine.



Bronzing Machine, for table use.

§ 8

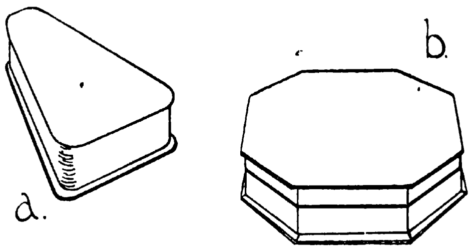
THE HAND-MADE BOX.

For commercial purposes there are very few boxes which are now made entirely by hand, as in those early days of the trade when a knife, a glue pot and a bench practically comprised all the tools and accessories a box maker possessed. In these days, what are known commercially as hand made boxes, if of a rectangular pattern, have their blanks prepared on the cutting and scoring machine as used for the manufacture of the machine made upright covered box. If the shape of the hand made box is round, oval, or irregular, then the board is first trimmed on the guillotine or hand shears and then cut to size on a round or oval cutting machine, or punched out to shape on a punching press. The scoring is then done with a hand scoring tool.

What constitutes the main difference between a machine and a hand made box is the subsequent operations. Generally speaking, a box is only glued up and covered by hand when it is of a shape which does not lend itself to automatic mechanical formation, or when it is of that expensive kind which requires expert and special handling. It is also understood that a hand made box is always of the upright or rigid kind, as distinct from those boxes which fold in a flat or collapsed condition when not filled.

For practical purposes there are, roughly, three different kinds of hand made boxes: the square-edged or rectangular; the round or oval; and the fancy-shaped. Of the first kind, as with the machine made upright covered

box, its size controls the method of forming the blank. If it is small, the blank is cut and scored out of one piece of board; if large, it is made out of three pieces of board, like an end-pieced box; a third variety is that of the shoulder box, of which the shoulder or neck is cut and scored separately and added, according to the size of the box, to a one-piece or three-piece blank. The round or oval hand made box body is made out of two pieces of board, one for the rounded side or wall, and one for the bottom; and when a shoulder or neck is required this is also made out of another piece of board.

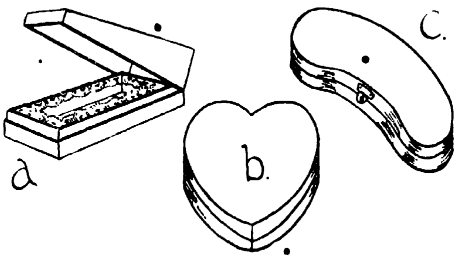


HAND MADE BOXES, showing (*a*) a tapered telescope chocolate box; and (*b*) an octagonal shoulder confectionery box.

The fancy-shaped box is usually punched out of one piece of board to the required shape, for making the top or bottom of the box, and the side cut out of another piece of board. This applies only to the telescope or slip-on lid box, but more shaped pieces of board are necessary if the same box has a hinged lid on the bottle-neck principle, as will be explained later. Certain kinds of fancy boxes are made out of one piece of board for the body and another for the lid, by being moulded to shape in a press and then finished by hand.

Paper boxes made by hand are produced on large tables or benches provided with cabinets or shelves for the

various tools required, glueing boards and glue-pots, and with the material necessary in a handy position. The work is usually divided, one operator assembling the blank and staying the corners, another covering the box and lid, and a third finishing the decorative work with such strips of gold or fancy paper as may be necessary. This applies to the ordinary rectangular box with a slip-on lid, but if a shoulder box is required, then another operator attends to that portion of the work before the covering is done. It is advisable to arrange the tables or benches in sequence so that no time is lost between one operation and the following one.



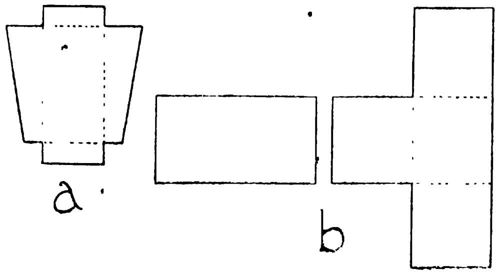
HAND MADE BOXES, showing (a) a sloped wedding cake box; (b) a heart-shaped wedding cake or jewellery box; and (c) a kidney-shaped jewellery box.

THE RECTANGULAR BOX.

For the average rectangular hand made box, it is usual to make up a dummy to calculate accurately where the sheet of board should be cut and scored. The latter operation can be done by hand, but it is more generally performed on a rotary card cutting machine or on a cutting and scoring machine. If done by hand, the board can be cut on the guillotine or with the hand shears. The cutting and scoring machine has been described previously,*

* See page 16

and the rotary card cutting machine is similar in pattern, having a number of circular knives or cutters at intervals on a rotary cross bar or roller. The board travels underneath the cutters, which separate the sheet into strips according to the width between the cutters. Most of these machines have a semi-automatic feeder, and a side gauge to ensure accurate cutting.



Blanks for Hand Made Boxes, showing (*a*) for a sloping lid; and (*b*) for back and upper tier of a cigarette cabinet. (The dotted lines represent the scoring marks.)

The guillotine is a heavy and powerful machine with a downward cutting action, similar in operation to the lethal instrument for capital punishment used in France from which it derives its name. The long knife is fixed into a stock, which has a long, sliding motion. In operation, several sheets of board are placed in position on the metal cutting table, and a clamp descends to grip the material as the cut is made. This clamp remains down until the knife has passed through the material in its upward motion or return, thus preventing any shifting of the pile. The material is easily adjusted to the size by means of a false clamp or other device, which shows exactly where the knife will strike the material. Any thickness of board, and a number of sheets at once may be cut in this fashion.

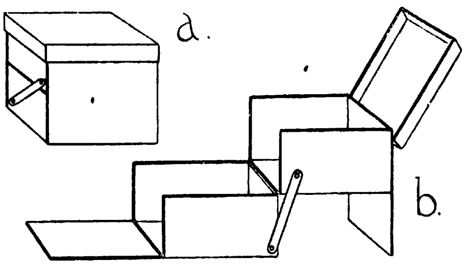
Most hand made box factories instal hand shears for cutting odd sizes of board, as are so frequently required, because of the easier adaptability of that implement. Hand shears have a laying-on table of hard wood or planed cast iron, with cast iron squares fitted in both directions and a gauge for estimating the size of the cut required. The cutting is done by means of an upper blade, which is carried on a curved arm pivoted and weighted to obtain balance, and a lower shear blade, bolted to the laying-on table and usually provided with screws to take up for wear after grinding. This form of cutting is known as the scissor cut, the operator placing the sheet of board into position by means of the gauge, and under a gripping rail which is operated by a treadle, a downward pressure on the upper blade arm handle severing the board.

Hand Scoring and Staying.

For the scoring of the cut board, if this is done by hand, the tool used is a metal hand roller with a rotary knife fitted between two sockets. The sheet of board is clamped on the work table between parallel bars at sufficient distance apart to allow the scoring tool to run smoothly between them. This method of scoring is only adopted for special jobs requiring careful treatment, and is not satisfactory for long runs of average work, which can be done better on the cutting and scoring machine.

Except for the tools and mechanisms used for the various processes in the making of a blank for a machine made upright covered box, the method of procedure for a hand made box is similar, whether it be of the one-, two-, or three-piece variety. For the one-piece blank of the hand made rectangular box, after it is cut and scored, the corners have to be removed either by hand with the knife or on the corner cutting machine. If the box is to be of three-piece or end stayed variety, the method of affixing the two ends to the rest of the blank is similar to that of corner staying.

For corner or end staying, the operator takes a length of narrow strip of kraft paper or cloth, according to the strength of stay required, and lays it quickly, holding first one end and then the other, on the glueing table, from which it picks up adhesive. This operation has to be done swiftly so that too much glue is not taken up. The glued strip is then fixed to each corner, cut-off to length with large scissors, and the box body is assembled. A similar procedure takes place in the making of the lid. The box is then ready for covering.

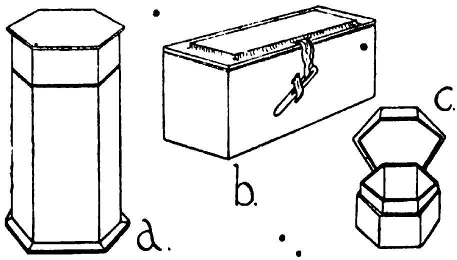


HAND MADE BOXES, showing (*a*) a double box cigarette cabinet closed; and (*b*) the same box opened.

COVERING AND DECORATING.

It is in this part of the work that the hand made box worker shows most skill. Because boxes are only made by hand where something unusual or elaborate is required, the covering papers are mostly expensive and delicate in texture. Consequently, great care has to be exercised to prevent spoilage or clumsiness. After the box is assembled, it may require a fine glazed paper inside with lace paper edging and a decorative paper outside with, perhaps, a gold or silver edging, as for wedding cake boxes. The worker therefore fixes these papers in sequence so that the following operation will not injure the preceding one.

The stayed hand made box generally has its inside paper glued in first and then the outside paper fastened round the walls of the box with a neat turn-in over the edges. If the box and the lid are to have a special edging, this is attached before the outside covering paper is applied. The covering paper must be of such a width as to show the edging and not to leave too much for the turn-in. After the outside cover paper is fixed, the lace edging is then attached to the inner walls of the box, and it is then complete. Each piece of covering paper is glued on the glueing table similarly to the stay paper. This applies to the box with the slip-on lid.



HAND MADE BOXES, showing, (*a*) a hexagonal telescopic confectionery box with extension top and bottom; (*b*) a cretonne covered perfumery box with a shaped lid; and (*c*) a hexagonal hinge-lid trinket box.

If the box has a hinged lid, then a piece of strong stay paper or cloth is glued and fixed to the lid and box body to form the hinge, before any covering is done, or each portion is covered outside separately and a stout piece of the decorative paper is glued on to one side of both the lid and the body. This kind of lid is used generally with a shoulder box, and in this case the shoulder, or neck, after being cut and scored to size, is covered with a glazed white box enamel paper (unless another kind of paper

is specified) and glued on to the interior walls of the box body. Care must, of course, be taken that the depth of the lid agrees with that portion of the shoulder which protrudes above the box body.

Some boxes, such as for the chocolate and confectionery trades, have extension bottoms or padded tops. For these kinds the box body or lid is assembled, stayed and covered on the sides only before the extension bottom or padded top is affixed. After this extra bottom or top has been cut to size (the tops being generally padded with cotton wool) the decorative paper is glued on, and the additional bottom or top is ready to be attached to the box or lid proper. Then the final decorative paper is glued over all or over the protruding edges to complete the box. Practically all rectangular boxes are made in this way and only a slight variation in cutting and scoring is required if the box has to have six or eight sides, or a sloping lid.

As such a large proportion of the cover paper is decorated with metallic tints, this operation, known as bronzing, is frequently done in the box factory. Bronzing machines are obtainable in all sizes to work on the smallest or the largest sheets, but a very handy machine for table or bench is made in four sizes : 15, 16, 24 and 32 inches wide. It will take thin papers or heavy boards, gelatine, textile or tin, and will operate for any kind of bronzing or dusting. Change from gold to silver bronzing can be made in a few minutes, and as the bronze duct is easily removable the machine can be used for dusting only.

Round or Oval Boxes.

For three industries in particular—those of millinery, medicine and confectionery—round and oval boxes are mostly made by hand. For the medicinal trade this applies to pill and powder boxes, and for the confectionery trade to the boxes to contain good quality chocolates and fancy sweets. There are indications that the moulded box made in one operation, as described previously, may take the

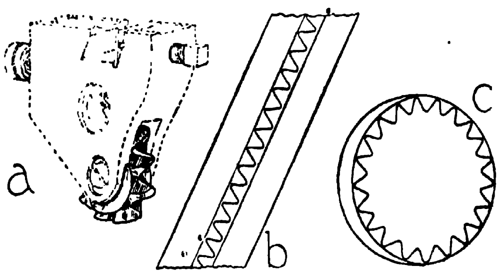
place of the hand made article for the medicinal industry, but in the confectionery and millinery industries there is as yet no serious rival to hand made round and oval boxes.

As with the square and oblong box, the hand worker requires experience to produce a neat circular box, and perhaps more skill. The round box operator usually is assisted by steel or hard wood formes or rings, according to individual practice, and in some cases by auxiliary machines, but it is on the aptness of the fingers that the quality of the work depends. When a small round box such as for pills is made by hand, it is formed out of four pieces of material : two round pieces of board for the box body and the lid, and two tubes or rings for the sides of each. If the box has a shoulder or neck another ring is required. Practically all round and oval boxes are of the telescope or slip-on lid kind, because their circular shape prevents the application of a hinge.

Various methods are adopted for the preparation of the round tops and bottoms and for the rings, and there are two ways of attaching the tubes to the tops and bottoms. The round tops may be punched out by steel cutters on a punching press, as for the moulded box, or they may be produced on a round and oval cutting machine. On the latter a thousand to twelve hundred rounds or ovals per hour can be produced. The sheet of board to be cut must be unlined, because it is held on the machine by small pins, though the holes made by them in the board are hardly noticeable. Three different formes or blocks are built on the machine, one for round cutting, one for oval, and the third for round-cornered oblong. These blocks, carried on the turn-table, can be swivelled, which prevents "falling" and makes it easier for the operator to turn the blank. The maximum dimensions of this machine are 20 inches diameter for the round cutting, 18½ by 16 inches for the oval, and 21½ by 17½ inches for the oblong.

There is also another method of shaping the tubes for large boxes of heavy material which enables the set-in

bottom or top to stand a greater strain than could be borne by staying material or a thin glued edge. This is done on a cutting and scoring machine, the rotary cutting knife being replaced by a flange cutting knife. As this cutter is shaped to make a continuous and rounded V-shaped cut, a scoring knife is fitted each side of the flange cutter so that the edges of the latter cut slightly between the parallel score marks. In this way the sides and flanges for two boxes are made simultaneously. The V-shaped flanges are then glued and fastened over the top or bottom end. This method of round box making is also suitable for smaller boxes where extension bottoms or tops are used, as the glue flanges do not show.

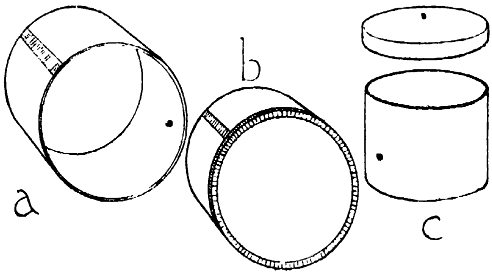


Hand Made Boxes, showing (*a*) a flange-cutting knife for round box making, set between two scoring knives; (*b*) a strip of board cut between score lines for making the flanges of two boxes at one time; and (*c*) the box made therefrom with the flange on the outside, the bottom being set in.

Forming the Round Box.

In the cutting of the round or oval top its diameter varies according to whether the box has a shoulder or not. In the former case the diameter of the top is similar to that of the bottom; in the latter case the top must be increased in size by just as much as will allow the lid to

slip securely over the box body. The top and bottom being made, the tube or ring for the side is the next operation. For large boxes, such as for millinery or chocolates, the tubes are made from a strip of flexible strawboard or pulpboard corresponding in length to the circumference of the top or bottom. For small boxes, such as for face powder or pills, the tubes are made from paper wound on a tube rolling machine.



ROUND BOX MAKING, showing (*a*) a stayed tube for a hat box; (*b*) the same with the bottom attached; and (*c*) the box with cover complete.

When the tube is made from board for a hat box, it has been found desirable to shape it round a wooden block or mandrel of a size similar to the interior measurements of the box. This wooden block can also be used for setting in the tops and bottoms and for covering. The board used is generally lined one side, the unlined side being the outside of the box. This also applies to the tops and bottoms. If this board strip is wound over the block it is fastened on the outside by means of stout stay paper or cloth, or, if the board is thin an overlapping edge may be left to be glued on to the other edge. The latter method is not frequently adopted because the overlapping edge causes a protuberance in the outer covering paper. Some box makers overcome this defect slightly by cutting

a long bevel on the outside of the overlapping edge. For this operation a board bevelling machine can be obtained, though an expert worker can do this by hand with a sharp knife.

Should the box be large it is preferable to fasten the tube with a thin strip of board which is wire stitched to both ends as they meet. This can be done on a long arm wire stitching machine. After the tube is fastened by one of these methods, it is slipped over the wooden block, the bottom end placed in position, and a narrow strip of glued stay paper or cloth fixed firmly over the adjoining edges. This operation requires skill to prevent crinkling of the stay or gaps between the edge of the tube and that of the end. The box body being thus assembled, the narrow strip of tube for the lid, also fastened, is slipped over the other end of the body and the top end set in with stay paper or cloth. The box is then ready for covering.

Chocolate boxes, of round or oval shape, are assembled similarly, except that tubes forming the walls of the box are not wire stitched. As they are by no means as deep as those of a millinery box, staying material or a small overlapping and bevelled edge and glue are sufficient to hold the tube together. Some operators dispense with a wooden form block for these smaller boxes and depend only on the aptness of their fingers or upon a narrow steel band for clamping the tube to the end after staying until it becomes firmly set. When an extension bottom or top is added, the tube, after the end is stayed to it, is sometimes covered with the decorative paper before the extension is glued on. This also applies if the box has a shoulder.

Powder and pill boxes, being still smaller in size, have their tubes made differently. In most cases a sheet of paper is wound three or four times round a mandrel of the correct diameter on the straight roll tube making machine, such as is used for the manufacture of certain round containers. Some hand workers dispense with this

machine, rolling the glued paper round a wooden metal mandrel like a cigarette is rolled. When these rolled tubes are dry they are cut to length on a tube cutting machine. The paper used is either good quality " news " or book paper, or, for the better class box, enamelled or coated paper; and of a weight from 50 to 80 lbs. to the ream. When the tubes are cut to the required depth they are either stayed to the ends, or, for the smaller boxes, glued on to the ends.

A simple way of glueing the tubes to the ends is by applying a thin coat of adhesive to the under edge of the former with a brush, then slipping the glued tube over the edge of the mandrel on which it was wound, and pressing the bottom or top end to the tube until they set firm. Further strength can be given to this join by the covering paper. With powder and pill boxes having a shoulder or neck, the tube for this is wound similarly to that of the box body and inserted, after glueing on the edges and a little on the sides, into the body after the bottom has been glued on. To allow the lid to slip over the shoulder easily some workers make a slight oblique score with a sharp knife on that part of the shoulder which projects above the body. Face powder boxes are frequently made with the lids crimped on to give a neat rounded edge and sunk in top to the box. This can be done on the crimping machine as used for round food containers.

Covering the Round Box.

In the covering of the round or oval box, if no decorative edging is required and the join of the tube to the end needs additional strength, the cover paper is cut slightly wider than the depth of the body or lid to allow for a turn-in on the inside and a turn-over on the end. The neatest work of this kind is done by making small V-shaped incisions along both edges of the cover paper to prevent wrinkling in the bend. This is particularly necessary for those boxes which have a decorative paper

circle or oval pasted on to the top or bottom. Allowance must also be made in the width of the cover paper if a special edging paper has to be shown. As with other shapes of boxes, in every case the edging paper is glued on before the body cover paper is attached.

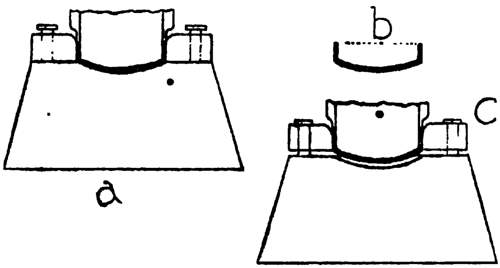
What applies to all hand made boxes, but more particularly to the round and oval kind, is that great care and skill are necessary to glue on a highly decorated paper so that the pattern appears to be continuous on both box and lid. As there are now some really beautiful box cover papers, such as those which reproduce Parian and other marbles, watered silks and other varieties of artistic embossing, it will be realised that much depends on the cleverness of the worker. Some boxes are enhanced by being fastened with gummed embossed seals where the lid joins the body, but this only applies to shoulder boxes. Pill and medicinal boxes are frequently supplied without covered tops, as most druggists and chemists fix their own gummed labels. Extension edge boxes are covered similarly, whether square or round, according to the amount of decoration needed.

Face powder and similar boxes are sometimes beautified by having domed and embossed lids, and this operation is usually performed on an embossing press. Various styles of this machine are obtainable, a popular kind being of the duplex pattern, capable of handling two lids alternately. This press is generally heated and, by means of brass male and female dies or moulds (convex and concave respectively), it shapes round and oval pieces of board into domes, and can, if necessary, emboss them in colours at the same operation. If labels are to be pasted on the piece of board to be domed this is done before the operation. The heat used is to prevent the board from cracking, and the box top remains between the dies long enough to acquire the desired shape. A flat edge all round the domed portion of the top is left for joining or crimping to the tubular sides of the lid. Some face powder boxes are fitted with a movable internal cardboard sieve, made

like a narrow box lid, but with the top perforated, through which a small portion of the powder percolates.

FANCY SHAPED BOXES.

Practically all boxes of fancy shapes are prepared with specially bent steel punches to make either the two shaped sides or the shaped top and bottom of the box. Nearly all the other operations are done by skilled hand work. The trade in these boxes is either seasonable, such as those of egg and rabbit shape for Easter or Santa Claus

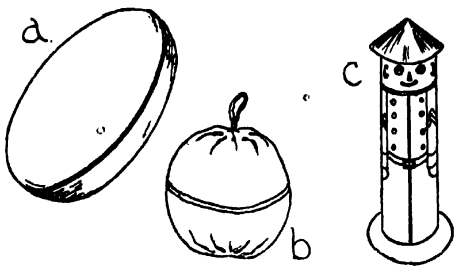


DOMING BOXES, showing sectional views of (*a*) the base and die for doming the lids of boxes; (*b*) the domed lid; and (*c*) the male die being raised after doming to extract the finished lid.

boxes for Christmas, or it may be of a special nature, such as for weddings, parties, jewellery, toys, etc. For weddings, fancy boxes to hold small pieces of cake are of the heart, fan, diamond, horseshoe or shamrock leaf pattern. Various designs are adopted to hold favours and trinkets for social events, while for the jewellery trade fancy boxes may be in kidney or heart shape. Fancy toy boxes are also of varied styles, such as to represent soldiers, houses, ships, etc.

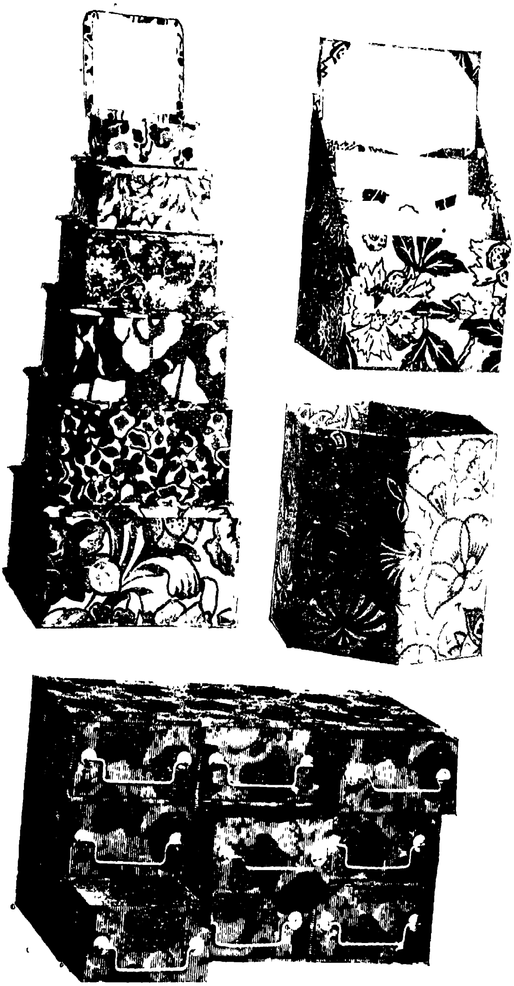
Boxes to represent Easter eggs and such fruit as apples, oranges, pears, etc., though rightly described as fancy shaped boxes, are only decorated and finished by

hand, the two shaped halves of each of these boxes being moulded by means of convex and concave dies as for domed box tops. The majority of fancy shaped boxes are either of the telescope lid or of the shoulder pattern, and when they are four sided the shaped parts are generally used for the top and bottom of the box. These boxes are made of two pieces of board for the body and two for the lid, a strip of board corresponding in width to the depth of the box or lid being used for the sides.



HAND MADE BOXES, showing (*a*) an Easter egg; (*b*) a moulded apple; and (*c*) a round telescopic pencil box.

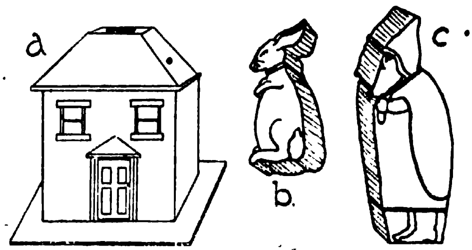
If the box has a shoulder, as with other kinds of shoulder boxes a wider piece of thinner board is inserted to form the neck. The only tools and accessories necessary after the shapes have been prepared are a sharp knife and scissors, a glueing board and glue; and perhaps a hand scoring tool. Some workers prefer to assemble and finish these boxes themselves because of their intricate shape, but in factories where the work is done regularly, different operatives are accustomed to certain definite processes, and each box is executed in sequence. The material used for these fancy boxes is generally of good quality to allow for delicate bending without cracking, and may be either pulp-board or coated board.



Types of Cretonne Covered Boxes.

Forming the Shaped Box.

In making an egg- or fruit-shaped box, the outer surface design paper is pasted to the thin board before moulding, and the finishing operation is usually the glueing of a thin strip of enamel covered board to the inner edge of the one half to form a shoulder. Some of these boxes have a thin loop of silk ribbon attached, and this is glued on usually under the shoulder strip at one end. A narrow strip of embossed or otherwise decorated gilt or silver edging is also pasted on the outside edge to trim the join between the upper and lower half of the egg.



Hand Made Boxes, showing (a) a house-shaped money savings box; (b) an Easter rabbit box; and (c) a Father Christmas box (both the latter being of the telescopic variety).

For the manufacture of heart, kidney, fan, rabbit or Santa Claus shaped boxes, a hard wooden or metal forme of the same shape is generally used and the strip of board to form the side is shaped round it. Bends in this strip are assisted by means of scoring lines made on one or other side with the aid of a knife or hand scoring tool. The ends that meet are then fastened with paper or cloth staying material, and the heart or other shaped top or bottom is fastened to the side by means of staying material round both edges or with glue. The box is then covered round the sides with a turn-over strip on both sides and a heart or other shaped piece of decorative paper pasted on

the top. Fancy edgings are glued on first and the side cover paper narrowed accordingly.

Extension tops and bottoms are fitted similarly as for other boxes. The insides of the boxes may be covered with glazed enamel or other fancy paper, which is pasted in after lace edging is fixed to the inner edges where this is required. Some boxes, such as are adopted to contain perfumery or jewellery, have padded interior beds, and these are generally made separately in the form of a cushion to the shape of the box and with an edging to glue to the box interior. Inside cover paper is always attached after these padded beds are fixed. Fancy boxes may also be covered with textile material such as cretonne, silk, plush or other fabric, or with leather, and may have metal clasps attached outside to form a lock for the box.

With this description that branch of paper container manufacture which deals with paper boxes is completed. A technical description of that other important branch of the paper container trade, paper bag making, will be the following subject.

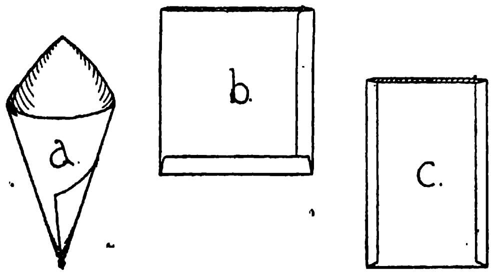
§ 9

THE PAPER BAG.

UNTIL about fifty years ago, paper bags were always made by hand. Sheets of paper were then cut to proper size and pasted up into receptacles by female labour, and it can be said that the same methods apply to-day, with the exception that now machinery strikes a more dominant note in paper bag manufacture. Nevertheless, it is still claimed by employers of human labour that a hand made bag is a superior article to the machine production, though, in many instances, the cost of production in ratio to output makes the latter a more commercial proposition. In pre-machine days paper bags were made solely for shop use, and for many years met with scant success because the average shopkeeper found it cheaper and simpler to wrap his commodities in the then familiar straw-coloured paper, or to make his own twisted package or cone. In fact, most grocers made their own bags, and some continued doing so until about ten or fifteen years ago.

The earliest types of paper bags were all of what is now known as the "flat" variety, originating as they did from the twisted paper cone, and the shapes gradually extended from that of the flat cone bag into the flat square and oblong shaped bags. Wrapping paper of those days developed from the rough dark brown quality into the stout and thin "kraft" paper now obtainable, and simultaneously with that development both the uses of the paper bag and its styles altered and increased as the demand became greater. The methods of manufacture

also became extended, and from those simple hand appliances of half a century ago, *i.e.*, the knife and the paste pot, there have descended the complicated automatic mechanisms which now make and print the paper bag complete from the reel of paper.

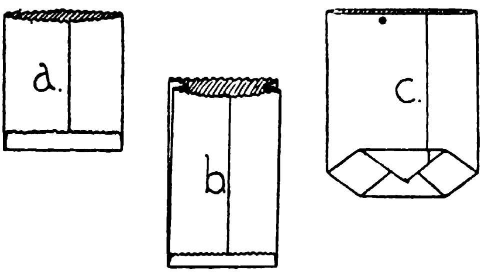


EARLY TYPES OF PAPER BAGS, showing (*a*) the hand twisted cone; (*b*) the square flat bag with side and bottom seams; and (*c*) the oblong flat bag with two side seams.

When the uses and styles of the paper bag became extended it was found that, as the needs of the various trades differed, so had the classifications of the bags to become more clearly defined. From the early type of flat bag with either the side and bottom seams or the two side seams, there came the flat bag with the centre and bottom seams, the manufacture of which is now almost a monopoly of machinery, and there are also machine made biscuit bags with seams at both side and bottoms. Then followed the bag with the extending side or gusset, having a centre seam and a folded over and pasted flat bottom, the manufacture of which is now also rarely done by hand. Finally, there developed the widely popular "patent" or square block bottomed bag, which had been and is still being used so considerably for packetting tea and other foodstuffs.

Two chief variations of the latter bag have been de-

vised; the "half-patent" or oblong block bottom bag, and the box-shaped bag. These varieties have been originated principally because the public has been accustomed to distinguish its purchases by the shape and size of the bag, and it is a remarkable fact that a quarter-pound of tea will not sell as readily if packed in the "patent" bag adopted for coffee, or *vice versa*. Consequently, there is an infinite variety of sizes in the same style bag, but for general and technical purposes it will be sufficient to give paper bags three categories, namely, the flat or plain, the gusset or satchel, and the patent or block bottom. Some paper bag making houses class the box-shaped bag, which also has a patent bottom, into a fourth category.



LATER TYPES OF PAPER BAGS, showing (*a*) the centre seam flat bag; (*b*) the satchel or gusset bag; and (*c*) the oblong block bottom (half-patent) bag.

Related to the paper bag proper, though not actually a bag because it is not made up as a container until it is being filled, is the paper wrapper. Square or oblong sheets of bag paper, single or lined with greaseproof, tinfoil, etc., paper, are fed into a machine which partially completes what appears to be a box-shaped bag, fills it with the prescribed contents (usually tea leaves), and seals it ready for sale to the public. Variations of this kind of paper container are cigarette, tobacco, confectionery and tablet

wrappers, with folded or twisted ends, the method of making which being similar from a general point of view. Finally, reference should also be made to a very distant connection of the paper bag, the crimped paper cup. This is widely adopted as a confectionery pocket or small cake baking dish, not sealed or closed, but used in its cup shape, as denoted by its name.

§ 10

THE HAND MADE BAG.

AMONG some manufacturing houses in the trade, hand workers prefer to cut their own paper in making paper bags, because they receive higher pay by so doing, and in such cases the sheets of paper taken from stock are first cut on the guillotine into such sizes as will enable the worker to make two bags from each piece. In other factories, the sheets of paper are cut to the required size on the guillotine,* a specially shaped knife giving the necessary flap to fold over where seams are required. For the latter variety a punching out press† and shaped cutters or punches are sometimes used. As a rule, each worker finishes the bag complete.

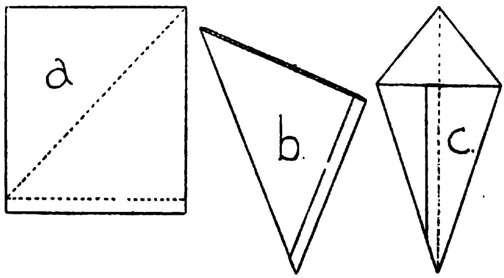
FLAT OR PLAIN BAGS.

The only tools required for making flat bags are a sharp, long-bladed knife, a bone folder, and a paste pot, as the dexterity of the fingers supplies the rest. For the manufacture of the block bottom bag an additional tool, the templet, is used. This is a thin metal (tinned) forme, shaped like, and slightly under the exact size of, the bag to be made. It is rectangular at the two corners corresponding to the opening of the bag and angular at the other end, which corresponds to the bottom of the bag. The angles of the latter portion of the templet, if extended, would meet in a half-diamond shape, and this angular portion is three-sided.

For the manufacture of the cone or kite shaped

* See page 138. † See page 130.

varieties of the flat bag, the cut sheet of paper, from which two bags can be made, is folded in half and then cut with the knife. Each portion would then be square but for the narrow margin on one side for the seam. These paper blanks are then spread out on top of one another so that only the narrow margin is visible, this operation being known as fanning out. Paste is then applied to the

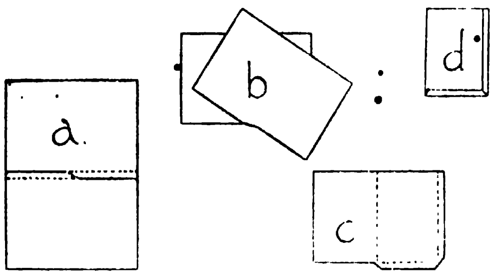


Hand Made Flat Bags, showing the cone and kite varieties, (*a*) being the blank, the dotted lines representing the folds; (*b*) the finished cone shaped bag made from that blank; and (*c*) the same bag refolded into a kite shaped bag.

margins of the fanned-out sheets, and most workers do this very dexterously with a sweep of the forefinger, preferring this method to that of the paste brush. Each sheet is then folded across diagonally so that the upper edges are parallel and the pasted margin is exposed. This is then folded over and stuck down, one end being twisted over twice to make the bottom powder-tight, and the cone shaped bag is complete. When this bag is dry it is sometimes opened out and then flattened the reverse way so that the seam appears in the centre and the back a half-diamond shape. In this form it is known as a kite shaped bag, although some firms describe it also as a cone bag.

In making the ordinary flat square or oblong bag with the side and bottom seams, the sheet of paper, from which

two bags can be made, is folded over twice near the middle, the first fold bringing one edge a little below the other edge, and the second fold bringing the first edge a little beyond the second. Between these two folds in the middle is the narrow margin from which the bottom seams of both bags are shaped. The sheet is then cut nearly half through one fold, and similarly, from the opposite edge through the other fold, leaving the centre of the whole sheet a small uncut strip. One corner of the sheet is brought over until a fold is made diagonally in the uncut sheet from the end of the cut through the first fold to

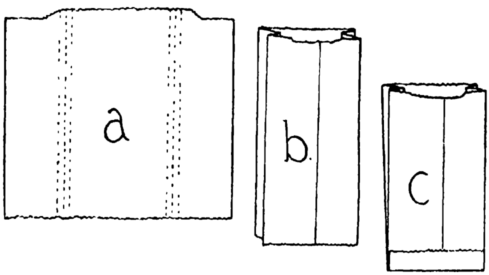


HAND MADE FLAT BAGS, showing the square and oblong varieties (*a*) being the sheet for making two bag blanks, with the first two folds and cuts, the uncut parts of the fold being shown in dotted lines, (*b*) the folded sheet ready for the diagonal cut; (*c*) the blank for one bag, showing the folds (dotted lines) and the final diagonal cut; and (*d*) the finished bag.

the end of the cut in the second, and this small diagonal fold is cut through, separating the sheet into two bag blanks each with a narrow protruding margin to make the bottom seam. The opposite end of this margin is also cut diagonally to match, and the bag blank is ready for pasting. These blanks are fanned out so that only the bottom and side seams are visible to receive the paste, after which each blank is folded and stuck down to complete the bag.

Satchel or Gusset Bags.

The sheet of paper used for making two satchel or gusset bags is cut into oblong strips, since these bags are, as a rule, elongated tubes with one end folded over flat to form the bottom. As these bags have to open easily it is customary to make one side of the opening slightly longer than the other to act as a grip for the fingers. This variation in size is obtained by folding the sheet twice across the middle similarly as for the square flat bag, but with a much narrower margin between the folds. The cutting is also different, as the two main cuts are made along the same fold, leaving the centre part uncut. Then more oblique diagonal cuts are made to the second fold from each end of the first fold cuts. The final and fifth cut is made along the second fold, severing the sheet.



Hand Made Satchel Bags, showing (*a*) the blank, the dotted lines indicating the folds for the gussets; (*b*) the pasted and gussetted tube; and (*c*) the finished bag.

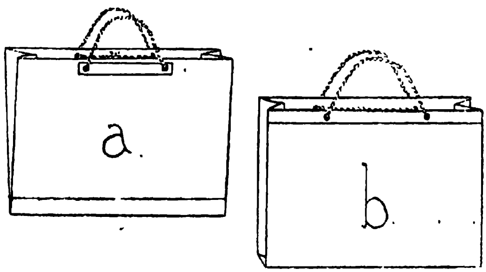
The cut pieces are fanned out and pasted down one side and at certain intervals along the bottom, so that the pasting will not prevent the folding of the gusset, as will be observed later. Each piece is then folded over and the centre seam pressed down. Then both sides of the flat tube are folded over again to make a narrow margin, and the original side edges are tucked in to form the gussets,

so that the second folds form the sides of the bag. The bottom of the gusseted tube, pressed quite flat, is pasted and folded over, and the bag is complete. Some workers use a templet for making both this style and the flat bag, finding that it gives greater rigidity to the shape and seam, and it is not an infrequent occurrence for a worker to make a temporary templet of cardboard, for a special size.

A development of the satchel bag which has received considerable impetus in recent years is what is known as the carrier bag. This is of the recognised gusset style, made of very strong kraft, and derives its name from the cords which are passed through both sides of the mouth and which enable the bag to be held comfortably for marketing purposes. Either the entire edge of the mouth of the bag or just that portion through which the cords pass are usually reinforced with a pasted strip of cardboard, and there are, of course, eyeletted holes for the cords. These holes can be made by hand, but they are usually punched out in one operation on an eyeletting machine. Sometimes the bottom of the carrier bag is also reinforced with a grooved and pasted strip of cardboard.

Most carrier bags, however, have a pair of cardboard washers affixed on each side of the mouth through which the carrying cord is passed. Fixing these washers to the bag can, of course, also be done by hand, but this is not practical, and there is a suitable washering machine to do the work. It is specially designed for making and fixing a pair of washers from a narrow reel of manilla or thin board, which is glued by a revolving glue roller, and then punched out and fixed to the bag automatically in one operation. The speed is from 2,000 to 3,000 per hour. Another machine of the same make glues, makes, and fixes two pairs of washers simultaneously, and there is an adjustment whereby the distance between the washers can be varied. Either section of this twin washering machine can be put out of action to run one pair of washers only, and both machines can be operated by foot or run continuously.

A carrier bag has been invented with a strip of board reinforcing the mouth, this strip having a special slot to effect a friction grip on the string of the handle. The slot is made tapering from one end to the other at each end of the strip. A knot in the string can be passed through the wide end of each slot, and by pulling the handle or by



HAND MADE CARRIER BAGS, showing (*a*) the satchel shape; and (*b*) the square bottom shape.

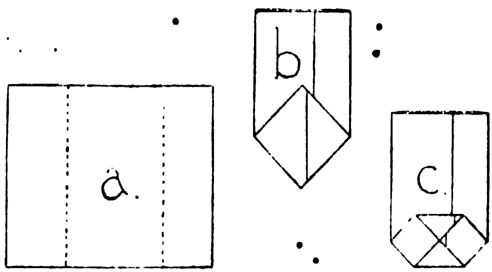
the weight of the bag when filled the string is wedged into the narrow end of the slot, and the bag is closed. This slot may be made in one or both sides of the mouth and may take various forms, such as the inverted comma or V-shapes. A cardboard tubular hand-hold over the string makes it more suitable for carrying.

BLOCK BOTTOM OR PATENT BAGS.

As there are no special divisions to be made, the sheet of paper, from which the two patent or half-patent bags are to be made, is simply folded in half and cut through. These pieces are then fanned out and pasted down one side for the centre seam. Each blank, taken off the pasted pile, is then folded round the templet so that the opening of the bag is flush with the rectangular edge and the other end reaches what would be the apex of the half-diamond shape were the angles of that end of the

templet to be extended. This operation is known as tinning. When the centre seam is pasted down, making a flat tube, the bottom end of the seam is lifted up and pressed back. This action folds the bottom into a diamond shape along the angular edges of the templet, and the overlapping seam is pasted down securely.

The ends of the diamond shaped fold are then pasted and folded over to meet each other if for a patent or square block bottom bag. This operation is known as nibbing. The templet is then extracted and the bag placed aside to dry. As the finished bags are placed one on top of another, and the worker is apt to be liberal in the application of paste, the bags frequently stick together.



HAND MADE PATENT BAGS, showing (*a*) the blank; (*b*) the folded and pasted tube with the diamond fold at the bottom; and (*c*) the finished square block bottom bag.

Care must be taken, however, that the adhesive does not spread inside the bag, as this causes it to tear open when being filled. The separation of the bags for counting and packing is a recognised operation, known as unsticking.

Another variety is the box-shaped bag, which is merely a square block bottom bag so folded that it has a gusset each side, is practically self-opening, and makes a square-sided packet. This style, however, is rarely made by hand because of the special folding, as with the satchel bag,

which is required to make the gussets after the ordinary patent bag is made. The box-shaped bag, when made by hand, sometimes has the assistance of a treadle machine, which comprises a series of metal blocks fixed to a bench. Each block is perforated at the top and a constant suction is kept up by a fan. The paper is pasted and folded round the block, a treadle pressing it close. The bottom of the bag is then folded and two lugs left to slide it off the block, and as it is taken off the suction draws in the sides and makes the gusset, the lugs being pasted down after.

Still another variety of the square paper packet, which is hardly so much a bag as a wrapper, and which was made more frequently before the satchel and patent bags were originated, is still used for packetting tea in some warehouses. The tools required for this wrapper are a block, a funnel and a rammer. The funnel is of metal and rectangular; the block is of wood and fits closely around it; and the rammer, also of wood and rectangular, has a handle and fits exactly inside the funnel. In operation, the sheet of paper is folded round the end of the funnel, a centre seam being pasted down. The overhanging end is folded into a block bottom, the nibs or ends of which are pasted down. The block is then passed over the wrapper to hold it firm. Then the required weight of tea leaves or other contents is poured into the funnel and pressed firmly in with the rammer. Upon extracting the funnel, the block holds the packet squarely, and after the rammer has finally pressed the tea down, the open end of the wrapper is folded and pasted down, the packet being ready for a covering label or seals at either end. This method of hand manufacture, has also been superseded by the use of automatic machinery.

§ 11

THE MACHINE MADE BAG.

THE first machine for making a paper bag was devised and perfected slightly more than half a century ago. It folded and pasted a continuous flat tube from a reel of paper, and this tube was cut by a mechanical device into different lengths. One end of each cut piece was then turned up and pasted by hand. Following this, a machine was invented for combining the two latter operations with the two former, and the finished bags, which were known in the trade as of the flat or plain variety, were ready for counting and packing prior to delivery to customers. This machine was followed by another new pattern which produced what was known as the square bag, folding up the sides of the paper tube and also turning up and pasting the ends.

From these early types there have developed a great variety of machines, each more automatic than its predecessor. Eventually, printing processes were also combined with bag making, until, at present, millions of highly decorated paper bags are produced weekly. For the purpose of these descriptions it will be sufficient to classify these machines under two sections: those which produce the bag from the sheet and those which produce it from the rolls of paper. The latter section is by far the more important of the two because it is simpler to handle the paper in reels, cut to required widths on slitting and rewinding machines after it is received from the paper mill,

and because all the operations are practically continuous. The former section, however, generally make for greater speed, although they are adapted more particularly for the manufacture of the flat or plain variety of bags.

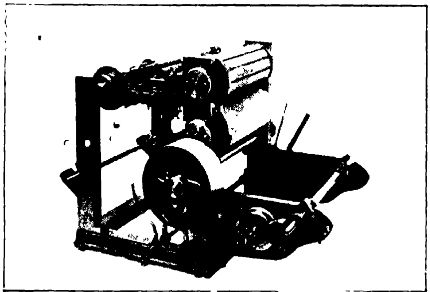
Dealing firstly with sheet fed machines, it is necessary for the paper to be cut on either the guillotine or the punching-out press, knives for the former or cutters for the latter being prepared to suit the special shape and size required. It is customary to use the guillotine for this process when either a straight edge or one with a slight projection (for the pasting flange) is required, as for a centre or side seam bag. When a more pronounced shape is needed, as for bags with closure flaps, it is preferable to use a shaped cutter and the punching-out press. The raw material used is similar to that for the hand made bag, most bag paper mills supplying the paper either in large sheets or in reels as ordered. Some mills, in fact, supply reels slit to required widths.

Sheet Fed Machine Made Bags.

Seed, flour, and other pulverent substances are generally packed in flat or plain bags, and for making these there is a rotary upright machine, at the foot of which is a feed table to take the cut sheets in a pile of two or three thousand. A suction feed takes the undermost sheet, so that the pile can be replenished without affecting the run of the machine, and passes it upwards through a series of rollers which in turn paste, fold, and secure the side seams until the finished bag emerges from the top of the machine on to a delivery table. This machine has an output of about 300 per minute, but it is not adaptable for variety in sizes or for many different thicknesses of paper.

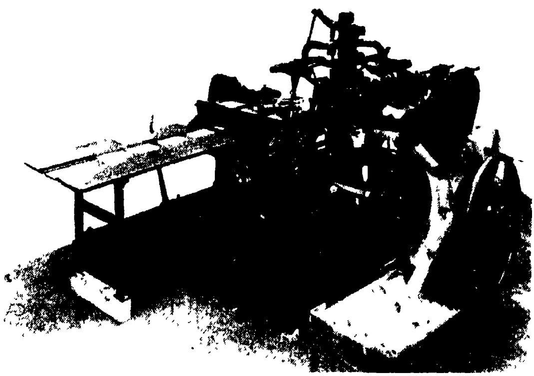
Another machine is designed for the production of flat paper bags (pockets), with or without flaps, for enclosing powdered goods, and though its output is about 4,300 per hour, it has the advantage of being adjustable to any size within its range. This is from 3 to 7 inches

Types of Bag Printing and Making Machines.



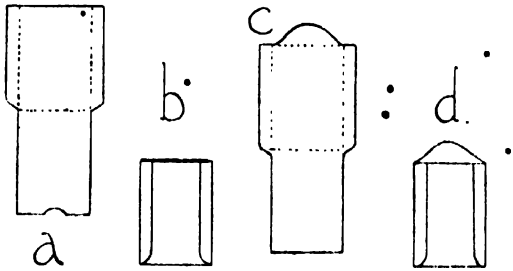
Printing and Rewinding Machine, for bag paper in the roll.

Block Bottom Bag Making Machine, from the roll.



Open Lined Bag Making Machine, from the sheet.

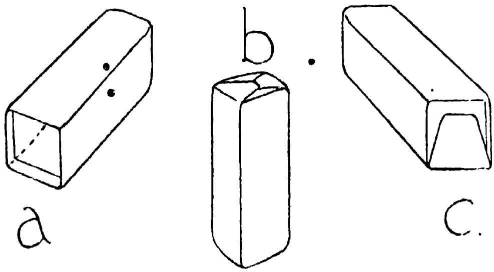
in length, and from $1\frac{1}{4}$ to $4\frac{3}{4}$ inches in width, exclusive of the flap. Between these dimensions, any size of bag can be made by changing the folding plate which controls the width and length of the bag. Changes of these plates from one size to another can be made in about fifteen minutes. The feed table will take a pile of 2,000 sheets, and it automatically brings the top sheet into position for its reception by the feeder, which conveys it to the gumming and folding devices. The finished bag is thrown into the delivery box on the right side of the machine.



MACHINE MADE FLAT BAGS, produced from sheets, showing (*a*) the cut blank; (*b*) the folded and pasted bag; (*c*) the cut blank for a bag with a flap; and (*d*) the finished bag.

There is also a different class of machine for making open paper bags as used by packers of tea, coffee, cocoa, cereals, etc., which consist of an outer printed wrapper cut from sheets and a lining paper taken from the roll. Both of these are folded and gummed separately, so that the finished article consists of two distinct bags, one inside the other. A variation of this machine is made whereby both wrapper and liner are folded together. The main advantage of these machines is that the bags are delivered in an open condition, ready for filling, and their appearance is somewhat improved by not having been previously

creased or folded. The output is about 60 to 70 per minute, and the machine only requires an unskilled attendant. As great pressure is applied to the bottom end of the bag, it can be used for the packing of fine powders. For gussetting and "knocking-down" a device may be added to make a knocked-down (collapsed) bag, if required. A similar machine delivers an imitation hand made bag, and another machine makes a ¼ lb. lined box-shaped bag at a speed of 2,200 an hour, while there is also a much cheaper machine to make unlined bags which must be hand fed.



Machine Made Open Bags, showing (a) the bag with lining, as turned out by the machine; (b) the bag filled and sealed; and (c) another form of end sealing.

Reel Fed Machine Made Bags.

There are several series of machines on the market for the manufacture of the flat (plain), gusset (satchel), patent (block bottom), or box-shaped varieties, varying slightly, according to the inventions of the firm making them, in construction, although similar in general style. In fact, it is commonly believed that there is now very little room for improvement, except in the case of speed and adjustability. Quite recently a somewhat new style of reel fed paper bag making machine has been placed on the market, to which reference will be made later, by

which the box-shaped or round bag is sealed at one end in a somewhat different manner from what is customary. The general style, however, has been, and is, to imitate as closely as possible the bag produced by hand work.

Machines in the latter class are fed from a reel of paper at one end, the paper passing through various cutting, folding, gumming, and pressing devices until it is turned out at the other end of the machine as a finished bag. For flat and gussetted bags an apparatus can be added to the equipment whereby bags are lined (*i.e.*, with another bag inside the outer wrapper). For printing the bags, other apparatus (to be described later) is obtainable, which prints either one or both sides in one or more colours. If the printing is required on both sides, the bag making machine produces the bag with the seam either at the side or at the centre. For the one side, one colour printing attachment, there is an adjustment whereby it can be moved aside so that unprinted bags can be made. Another method of printing bags is by running the reel through a rotary printing machine with a rewinding attachment, the printing appearing at prescribed intervals on the roll before it is placed on the bag making machine.

Kite and cone shaped bags are also produced from the roll by machines which have large outputs. As many as 15,500 of these bags, 2 oz. size, have been produced in an hour, the bags being automatically divided into lots of 100. Each of these machines is made for only one size of bag where large runs are required, and can be equipped with a printing attachment. Then there are machines for making lock seam millinery and laundry bags, of which a wide range of sizes can be obtained, and on these an attachment can be provided for making blouse or shirt bags with an unpasted flap. These lock seam machines can also be fitted with either a one side, one colour printing attachment, or an apparatus for printing bags in more than one colour, on both sides. Most of the plain, flat bag making machines which are reel fed, have a drying cylinder, and an automatic counting and delivery

apparatus. Their output varies with the length of the bag required, but 10,000 an hour is a very fair average.

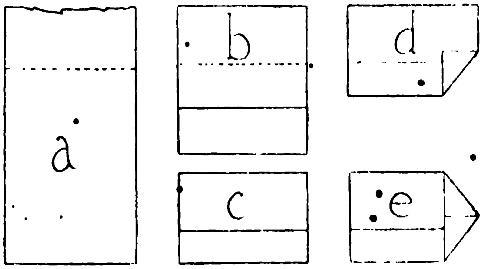
There is a comparatively new paper bag making machine for plain and satchel shape bags in which no drying cylinder is used. This is due to a different method of pasting, and the cut-off is of the rotary pattern. Attachments can be provided for printing reel register, for lining, and for side seam work. A one or two colour printer can also be supplied to work in conjunction with the bag machine, which is made in five sizes, the smallest to make bags up to 9½ inches wide by 18 inches long and the largest up to 28½ inches wide by 80 inches in length.

Block Bottom Bags from the Reel.

One of the most important developments in paper bag making machinery history took place when what was known as the patent or block bottom bag was produced in that way. There are now so many improved machines in comparison with the old type of "rose" machine that they may almost be described as belonging to a different class. Generally, these block bottom bag making machines are built in two types, one for making ordinary "rose" bottom bags with a wide range of sizes, and the other of simpler construction for large runs, which has not so wide a range, but is simpler to handle and capable of a much higher speed. Machines are also built to make one size of bag only and these are entirely automatic, requiring very little attention.

Most of these block bottom bag machines can be equipped for making lined bags and also for printing the bag in one or two colours on any part of the surface cleared by the pasted seam. Another type of machine makes unprinted bags, single or lined, square, oblong, or round, and it delivers them either open or folded flat as required. One machine of this type is specially designed for high-class tea, cash, etc., bags, which requires sustained pressure applied to the seam and the bottom. The rotary machine

of this type will make plain, sugar, etc., bags, greaseproof liners, or lined bags. Their general output is about 25 to 40 per minute, dependent upon the size of the bag, and for the type which makes greaseproof liners or inners there is an adjustment which automatically inserts the liner in the round box.

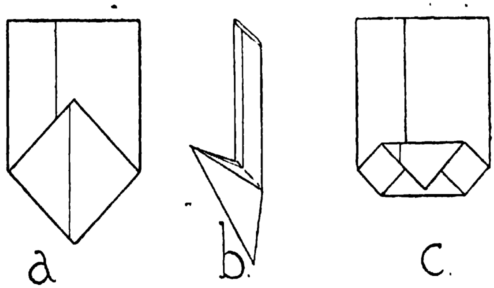


MACHINE MADE HALF PATENT BAGS, showing (*a*) part of the continuous web of paper, the dotted lines indicating where the cut is made for the bag blank; (*b*) the first fold, the dotted line marking where the second fold is made; (*c*) the folded and pasted tube; (*d*) the first half diamond fold; and (*e*) the two half diamond folds.

It will be sufficient to define the various processes of one of these types of machine to indicate the general method of their operation. Suitable feed or draw rollers and a severing mechanism are used for dividing the continuous web of paper from the reel into sheets of the required size for making the bag. These feed and severing rollers are suitably provided with change wheels whereby a variation of speed and size of bag can be obtained. As the sheet of paper leaves the last set of feed rollers it is guided into a device which served as a combined former and dipper. This is a collapsible appliance made from sheet metal plates hinged together.

A portion of each plate is cut away at the left hand end so as to produce an angle-shaped gap when the plates

are opened. If the plates were turned into perfect alignment, the gap produced would be a half-diamond shape, and the angled edges mark the lines for the first half-diamond fold of the bag. The sheet lies partly round the former and dipper, the plates of which close on a portion of the sheet to form the fold, moving it towards the creasing rollers. The sheet is then creased to form a tube length, which is done by another dipper device, and a suitable pasting arrangement completes the same. The second part of the folding is generally done at right angles to the first part, and this brings the sheet forward at such an angle, so as to make another half-diamond fold on the bottom, similar to the previous one. A small paste line is then made to secure this overlap upon subsequent pressing.



MACHINE MADE HALF PATENT BAGS, showing (*a*) the full diamond fold; (*b*) side view of the full diamond fold in process of folding; and (*c*) the finished oblong block bottom bag.

The second fold is made by a kind of butterfly device which enters the slightly gaping bottom of the bag, so that, if looked down upon, it would appear to be of an L-shape. The further formation of the bag bottom consists in turning over the small triangular folds on the right and left sides. This can be done either by plough devices or hinged or pivotted pressers, and small dabs of paste are

applied previous to the turning over. These last folds are then pressed securely and the bag bottom is complete. Finally, pressing rollers deliver the finished bags to the counting or assembling mechanism for delivery. Some machines of this type are built in two sizes, one to make bags from 2 oz. to 4 lb. size, and the other from 1 to 14 lb. size, with an output of about 110 per minute, according to the capacity of the bags.

PRINTING ON PAPER BAGS.

Various machines have been evolved from time to time with the object of producing a printed bag in one operation, but the main difficulty has been that the high speed at which the average bag making machine delivers the finished bags, did not enable the ink sufficient time to dry, thereby causing smears and set-off. The scientific help of the ink maker in supplying quick drying inks, coupled with the approved types of rotary printing machines now available, have done much to overcome this difficulty. One particular method of printing, embodying what is known as the off-set principle, has secured excellent results where two or more colour work is required. For single colour work a simpler form of printing machine has been devised, in which, as far as the distribution of the ink is concerned, the heavy vibration is placed on the inking cylinder instead of by distribution on the composition rollers.

The off-set printing process,* including as it does impression from rubber plates and special quick drying inks, has been responsible for first-class work being turned out at a very quick rate, and it has proved to be one of the most economical forms of bag printing. This is partly due to the method whereby the printing mechanism is coupled to the bag making mechanism so that the speed of the latter controls the former, although the printer can be thrown out of use if unprinted bags are required. The bag making machine is provided at its front end with a

* See page 62.

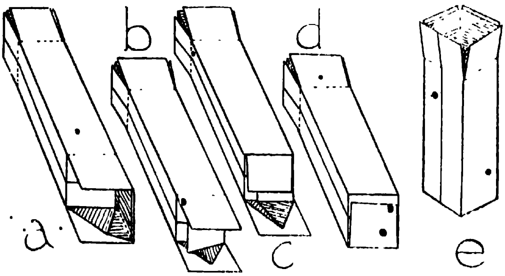
continuous rotary printing machine, beneath the printing cylinders of which there are a pair of draw rollers geared together and driven from the printing cylinders at the same surface speed. As the web of paper passes from the roll between the printing and impression cylinders of the printer, the draw rollers take it to the bag making machine. This regulates the length of printed paper supplied for the manufacture of the bag.

As the speed of the draw rollers determines the rate of travel of the printed paper passed to the bag making mechanism, the drive of these rollers synchronises with the intermittent movement of the bag forming section, and this causes the two machines to run as one. To accomplish this, a change-speed wheel on the driving shaft of the printing machine is driven at the same surface speed as the cylinders by means of a mounted intermediate gear wheel and an endless chain. The drive from the bag making machine thereby is similar to that of the printer. It has been found advisable to fit a separate printer for each colour so that the chromatic effects are produced in sequence, as is usual on rotary multi-colour printing machines. As the manufacture of the rubber plates is not a costly matter, the adoption of this method of printing bags is rapidly becoming general.

WRAPPERING MACHINERY.

Another class of machine, of which two or three different makes have been constructed, is used for making block bottom bags from the reel in a series of consecutive operations so that when the bag is formed and the bottom end sealed, it is ready for filling with granular or powdered foodstuffs on the same machine. This then completes the operation by sealing either end and delivering the filled bag as it is sold to the public. Tea, coffee, cocoa, tobacco and similar substances, when supplied in large quantities of packets, are frequently wrappered on this type of machine. Most of the bags made in this manner are lined with either

greaseproof or tinfoil paper inners, or both, and, in this case, either two or three reels are fed into the machine simultaneously. The outer bag is generally made from previously printed and re-reeled paper. It is also possible to feed this machine with paper cut to the required size, in sheets.

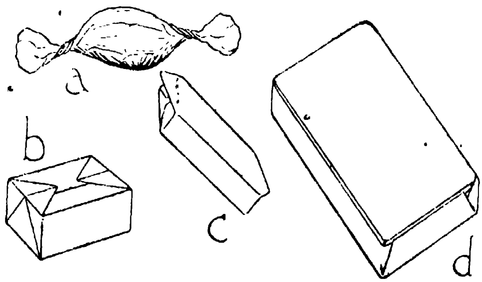


Box-Shaped Wrappers, showing (*a*) the first fold of the bottom end of a lined and pasted square blank; and (*b*) and (*c*) the second and third folds respectively; (*d*) the bottom sealed; and (*e*) the bag on end ready for the filling machine and final closure.

From the reel, the paper is taken automatically, gummed, cut off to blank size and then folded round a series of formers. The bag thus formed is then delivered into a revolving wheel of receptacles under which operates very efficient vibrating mechanisms than can be regulated to any desired extent by means of a hand-screw. Twin funnels are provided for feeding the tea or coffee, etc., into the open bag from four automatic weighing devices, and the machine is capable of taking the full output of this. Thus, when the quantity of the contents is small, the speed of turning out filled bags may be as much as 70 to 75 per minute, but when the weighers are designed for quantities from $\frac{1}{4}$ to $\frac{1}{2}$ lb., the speed is generally about 60 to 65 per minute. The speed of the machine depends entirely upon the weighing devices and not on the bag-making and

packing mechanism, which is constructed to work at any rate at which the contents can be fed into the bags.

Either single or double bags separately folded and gummed, or folded together, can be made on this machine, the wrappers being fed from reels or by automatic sheet feeds. Appliances can be provided for feeding cards into the bags before they are finally sealed, or for applying labels at either ends or along the sides. For powdered contents the folds are sharply and evenly made to make the



CONFECTIONERY AND CIGARETTE WRAPPERS, showing (a) a "twist" wrapper; (b) a caramel wrapper; (c) a chocolate wrapper; and (d) a wrapper for cigarettes.

bags powder-proof, but special contrivances can be added, if required, for folding and securing the bottom end of the bags similarly to that of the ordinary flour bag with block ends. All the parts of these machines should have large wearing surfaces and be carefully balanced to ensure regular and even running. The most serviceable makes are complete on one bed plate and not a series of machines joined together. In the same category of wrappering machines are those for packing tobacco and cigarettes, for wrappering rectangular tablets or packets such as soap, blacklead, washing blue, chocolate, etc., and for applying labels, stamps, etc., to tins, packets or tablets.

In connection with the latter variety of wrappering

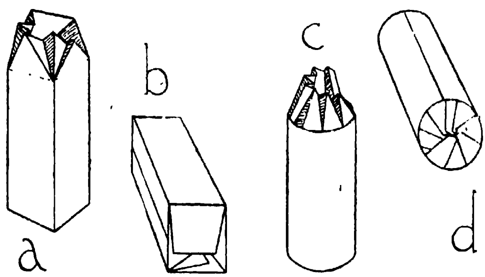
machinery there is a labelling machine which works in conjunction and which applies bands or labels to articles of a rectangular shape such as packets of tobacco, tea, soap, confectionery, etc. This machine has a capacity of 60 to 70 a minute, without any smear on the labelled packet, and labels are taken automatically from a magazine holding about 3,000. Each label is gummed under even pressure and placed tightly round the packet by means of mechanical fingers.

There is also a comparatively new form of wrappering machine which will produce a bag or container of any desired polygonal or tubular shape. The paper for this bag is taken from the sheet, cut to the required size, and then pasted and wound round a rotary mandrel of the shape in which the bag is intended to be formed. In winding the sheet of paper round this mandrel, a portion is allowed to overlap, and this overhanging portion is progressively pleated into overlapping pleats to form the bottom end of the bag. The bottom of the bag is thus sealed by a series of glued pleats or folds, each of which in turn is superimposed upon the preceding fold. These folds are formed by a number of stationary abutments in the machine, and they are so shaped as to cause that part of the blank by which the folds are to be produced, as the mandrel takes the folded blank along, to come into contact with these shaped surfaces consecutively until the bottom of the bag has been completed by the last of the abutments.

In this way it is possible to make either a single or a lined bag, and there can be any number of linings. For instance, if a bag is to be made with a greaseproof lining a sheet of the latter material is glued or otherwise adhered to a sheet of the outer covering or wrappering paper. The blank then consists of the cover paper with the greaseproof stuck thereto, both cut to the required size. It then passes on to the mandrel for folding. The same machine can be made for sheet feeding either by hand or automatically. The mandrel round which the bag is folded is of the expanding type, fitted with either a gripper to receive

or a vacuum to hold the blank while the mandrel is moving through the various stages of the operation.

The body of the bag is formed simultaneously with the folded bottom by the blank being wound on to the mandrel, and the final shape of the bag and the number of folds produced depend on the number of sides or revolutions given to the mandrel. A gear wheel attached to the latter meshes with a stationary gear. Consequently, the revolutions of the mandrel co-operate with the folds on the bottom, so that the bag is completed as the mandrel



DUST PROOF BAGS, showing (*a*) a square shaped bag, with the folds before closure; (*b*) the same bag sealed; (*c*) a tubular bag with the pleats or folds before closure; and (*d*) the same bag sealed.

revolves. If the number of mandrels is increased, a larger output will be obtained, and it is possible, by means of small alterations, to adapt the same machine for the production of what are known in the trade as canister bags or patent bags, these being delivered either open or collapsed.

A machine which has been described previously* in connection with the production of folding boxes is also applicable to the production of lined wrappers which can be completed and filled with tea or other foodstuffs on the wrapper making and filling machine. The object of making lined blanks on this machine is that of making the bags powder-proof, and of saving the time and labour occupied

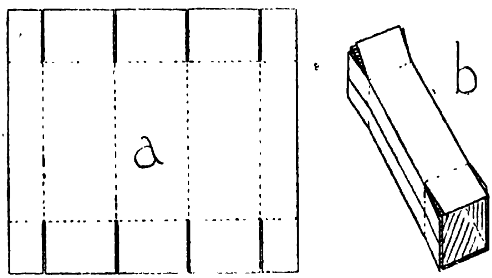
* See page 73.

in making the outer wrapper and liner separately. The output is thereby doubled, since this form of blank can also be used for making a lined box-shaped tea bag. The outer and lining papers are taken from separate reels, and as the web of each passes through the machine they meet, after leaving the glueing rollers and being cut to the required size, to pass through further rollers, which press them together securely. The cutting of the outer blank is arranged to allow for the folds at the top and bottom ends of the bag, for sealing. The glueing is so arranged that when the ends are folded over for sealing, they take with them the lining paper to make a powder-proof closure.

When the lined blank is cut and glued, it passes through the printing attachments. There is a separate printing attachment with ink distribution rollers and impression cylinders for each colour required, so that it is possible, by adding to the number of such printing attachments to obtain from two to six, or even eight colour work. By means of a hand lever it is possible to throw any or all the printing attachments out of operation, to permit of unprinted bags being made. When the printed or unprinted blanks are completed on this machine, they are delivered on to an endless travelling band, in a manner to prevent set-off if printed, and are then ready for either the wrapper making and filling machine or for the box-shaped bag machine. It is possible for the blank to be so cut as to form one of the flaps for end folding into a round or other shaped seal, which is suitably printed during the process of manufacture.

On the box-shaped bag machine these blanks can be made, according to their size, into a ⅛-, ¼-, ½-, or 1-lb. bag. Four separate machines are produced for each of these sizes. The ⅛-lb. bag can have a maximum width of 1⅝ inches and a minimum of 1½ inches; the ¼-lb. size, 2¼ to 1¾ inches; the ½-lb. size, 2¾ to 2⅜ inches; and the 1-lb. size, 3⅛ to 2⅞ inches. For the depth of the bag the maximum is always less than the width selected, by ⅛ inch in 1-lb. size and 1/16th inch in the other three sizes,

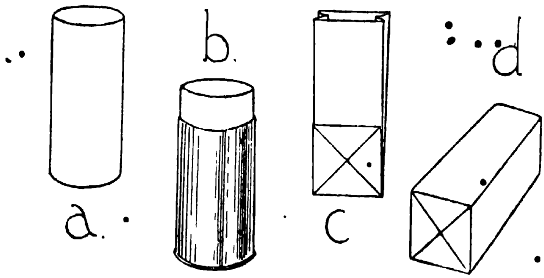
but the machines are adjustable to make bags of less depth than the maximum to the extent of about ½ inch less on the 1-lb. and ½-lb. sizes, ⅜ inch in the ¼-lb. sizes, and ¼ inch less in the ⅛-lb. size. Practically any length of bag can be made within the following limits : 8 to 10 inches on the 1-lb. bag; 6½ to 8½ inches on ½-lb.; and 4½ to 5¼ inches on the ¼- and ⅛-lb. sizes. For this class of machine it should be noted that the best results are obtained from a lined sheet of a combined substance of from 50 to 120 lb. (Double Crown size) to the ream. In no case should less than 35 lb. Double Crown substance be used.



Box Shaped Bags, showing (a) the blank for lined tea bag; (b) the pasted and lined tube, the shaded part representing the lining.

The blank made on the previously described machine, if made for the following machine, is wound round a solid forme of the size of the bag and formers tuck in each glued flap in sequence until the fourth fold seals the bottom end of the bag. When the bag is filled, a similar arrangement of formers seal up the top end of the filled bag. On the box-shaped bag machine, the blank has to be cut much more simply, and the bags are formed flat with gussets, and self-opening. Given an operator of average ability, it should be possible to arrive at an output of 15,500 bags in a day of 9 hours, but the actual speed of the 1-lb. machine

is 1,800 per hour; 2,000 per hour for the ½-lb. size machine; and 2,200 for the ¼- and ⅛-lb. sizes.



MACHINE MADE BAGS, showing (*a*) a finished liner; (*b*) the liner inserted into a round box; (*c*) a box-shaped bag in the flat; and (*d*) the box-shaped bag filled and sealed.

PAPER TWINE SACKS.

There has also been developed in recent years the manufacture of sacks from paper twine to replace the hemp and canvas bags formerly used for carrying heavy quantities of such commodities as cement, brown sugar, hypophosphate of lime and, during the war, sand for trench parapet building. The raw material for these sacks is kraft or similarly strong paper, either made or slit into narrow strips, which are twisted into twine, or else fibrous strips are made from the pulp direct on the specially adapted paper making machine. Quite a remarkable strength has been given to this product, and the sacks made from it have been found satisfactory to carry as much as a hundredweight of powdered or granular substances.

In making the narrow fibre strips on web or cylinder paper machines, the fibre pulp is separated into strips by the aid of jets of water or air. The strips are led over a travelling surface in a vertical direction, so that they hang freely in a loose state and as a kind of curtain influenced

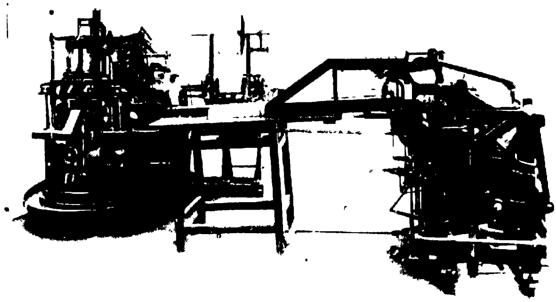
only by their own weight. From this curtain the individual strips are led away by a number of weighing devices which are associated with roving or rounding appliances, to give the strips the appearance of twine. The strips are then wound on spools, and, throughout the process of their manufacture, no tension is exerted on the strips, thus enabling them to have an even consistency. An endless felt cloth or apron which follows the web or cylinder paper machines conveys the fibre strips to the devices, which convert them into rovings by rubbing or rounding them.

When reels of slit kraft are used, the web of paper passes through a mechanism which damps it slightly at first and then twists it until it represents twine in strength and appearance. The paper twine made by either of these methods is wound on to spools, from which it is woven in carpet fashion on simple looms into lengths corresponding to the size of sack required. Each length of woven paper twine is then folded in half and fastened along the edges by intertwining or lacing to form the sack. Additional strength has been given to these paper sacks by reinforcing the woven paper with thin wire, but as a commercial product the ordinary woven paper sack has been found to possess sufficient tensile strength and durability. The cost of production is, of course, much less than that of sacks made of hempen or similar materials.

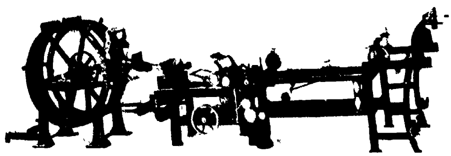
PAPER CRIMPED CUPS.

This attractive form of paper container has now achieved popularity because of the confectionery trade, being used in increasing quantity to hold the better-class sweetmeats, crystallised fruits and pralines. Crimped cups made from greaseproof paper are also used considerably as baking dishes for small cakes, but not only this material is adopted for the manufacture of crimped cups, since they may be made from various kinds of white and tinted papers, tinfoil, or even from gelatine. In their general form, these cups have a plain circular base and a fluted or crimped side, which may be of even height all round or end in four points.

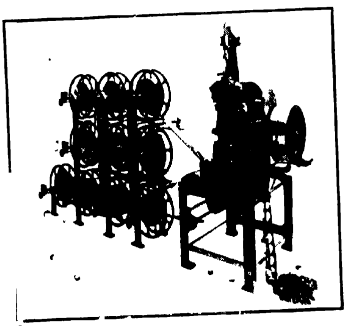
Types of Bag Making and Crimping Machines.



Packetting Machine, coupled direct with Labelling Machine.



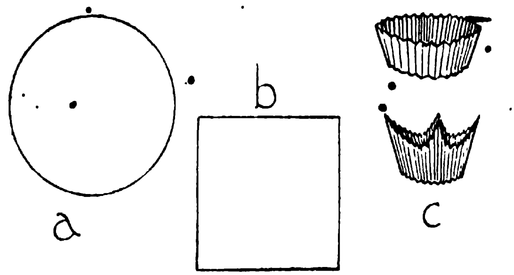
Rotary Reel Fed Bag Making Machine.



Crimped Cup Making Machine, with 10 Reels of paper.

The blank for the former shape is circular with either straight or scalloped edges, and for the latter square.

For the latest kind of crimped cup making machine, the paper is fed from a narrow reel, and ten or twelve reels are fed simultaneously into the machine, so that the webs of each reel travel over the roller in layers. The webs of paper first pass through a dampening attachment for making the material ready for the operation and adjustments correct the tension upon each of the webs of paper, so that absolute flatness and register are obtained. The



CRIMPED CUP MAKING, showing (a) the circular and (b) the square blanks, and (c) the finished cups made from these blanks.

cutting and crimping operations are practically simultaneous, as the downward plunger of the machine carries both the circular or square cutting tool and the male crimping die.

The flat webs travel under the plunger, pausing there while it descends so that the cutting tool punches out the blank and the male die continues the downward movement, pressing the blanks into a correspondingly formed female die. These dies are serrated to give the crimped sides to the cup, the upper, or male, fitting accurately into the lower, or female. Pressure is applied to the upper die, and for all paper materials, but not for tinfoil and gelatine, the

dies are preferably heated. A short dwell between the dies forms the crimped wall, after which the plunger descends further pressing the finished ten or twelve crimped cups through a gas-heated tube to dry until they drop into the delivery box below.

Another machine is also obtainable for giving a double turning fold to the uppermost edges of the cup, as is generally used for soufflé dishes. Should the discs of paper from which the cups are to be made require printing in one or more colours, the printing must first be done in the reel and then the shaped and printed discs cut out separately. To meet this requirement there is also a crimped cup making machine which handles the cut discs of material.

With this form of paper container the series is completed, and the next section will deal with the chief sundry materials required for the manufacture of paper boxes and bags.

§ 12

AUXILIARY MATERIALS.

In addition to the staple raw materials, cardboard and paper, there are used by the manufacturer of paper containers, whether boxes or bags, sundry auxiliary materials. In this category, pride of place must be given to adhesives because they are used so extensively. A large variety of grades and qualities are obtainable, each of them mainly suitable for definite processes, and, so important a part do they play in the container making factory, that a noticeable loss can be sustained by the manufacturer if due care is not exercised in their purchase and handling, either through lack of the necessary knowledge or of the proper facilities for preparation.

Perhaps next in importance as auxiliary materials, though only for the paper box making trade, are stay paper and stitching wire. Of these articles little can be said except that the best qualities of each prove to be the cheapest in the end. It must be remembered that the life of every paper box, except the carton, depends chiefly upon the strength of either the stay paper or stitching wire which holds the sides together. This applies with particular emphasis to corner staying paper or cloth, of which the adhesive power of the gum coating is as important as the tensile strength of the material. As for stitching wire, the kind which rusts is almost valueless. The tinned or coppered varieties should always be specified, and the false economy of using a wire too thin or weak for the work

must be avoided. Reference will be made to the tables of different gauges in a subsequent section.*

A more recent adjunct to the group of auxiliary materials is the waterproofing compound, and several varieties have been tried for different requirements. Where the waterproofing material is required for the manufacture of fibreboard packing cases for rail or sea transit there is a fairly wide field, and some of the methods adopted have been described in the section dealing with Raw Materials.† With these processes the paper box or bag manufacturer (the latter for the paper from which waterproofed or grease-proofed bags are made) is not so greatly concerned, as board or paper in a proofed condition will be easily obtainable without further treatment being necessary in the container making factory.

This does not apply, however, to the waterproofing of food containers, as the process involves the use of a material which must prove to be perfectly innocuous to the human digestion as well as non-injurious to the contents of the box or bag. For this reason, some of the methods and materials that have been found suitable will be described later. Similarly, the following pages will also deal with the qualities and treatment of adhesives from a a practical point of view.

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* See page 214. † See page 7.

§ 13

ADHESIVES.

So much adhesive is necessary to the various processes in making the upright covered, the folding and the round box and the paper bag, apart from other operations in the container making factory, that the choice and preparation of the glue, gum or paste required have developed into fine arts. Adhesives are rarely bought in the condition they are used. Many kinds require mixture with either hot or cold water before usage, and there are various qualities in both of the two main categories, animal glue and vegetable glue. Animal glues are made either from bone or hide, and are obtainable in ground, flake, cake or jelly form. Vegetable glues are produced from potatoes or similar starchy growths, and are supplied in a powdered, viscid or liquid condition.

When purchasing an adhesive the user should obtain an instruction list giving the amount of heat (if any) to be applied, the quantity of water, the method of mixing or cooking, the length of time it can stand afterwards without deterioration, and the covering power in, say, square inches of an ordinary coated paper for a given quantity. The use of this information in the factory should be accompanied by instructions that the required spread is obtained. Though certain adhesives are sold with the claim that only cold water is needed, it will be found preferable in most cases to use warm water, as a greater quantity will be taken up and the process of mixing made easier. It must, however, be borne in mind that hot water thins the glue. A

good method is to commence dissolving with warm water and to finish with cold.

The two important properties of glue are commercially known as jelly strength, *i.e.*, binding power or sticking strength, and viscosity (the "body" of the solution), the property that governs the amount of "spread." The latter quality is most important in a glue for ordinary paper box work, and therefore it is not necessary to use a hide glue, higher in jelly strength, when a low grade bone glue will be sufficient. The purchase of the right glues does not, however, solve all the manufacturer's difficulties. As great a care, or even greater, must be given to their preparation. In this, vegetable glues do not require so much attention as animal glues, since the latter may easily cause a substantial loss in covering quality by excessive heat, overcooking, or standing too long. Animal glue should be of a quality which has not a nauseating odour because that indicates putrefaction and a consequent loss in quality.

Preparing the Adhesives.

In preparing a hot glue one of the best ways to avoid waste in animal glue is by the application of a glue dissolver and filter. This appliance enables large quantities of glue to be handled a little at a time, and no matter how much glue solution may be required per hour or per minute, it will be available without the necessity of keeping a quantity of hot melted glue on hand. This new method abolishes at once the old plan of glue cooking, with its inevitable waste. In recent times considerably more attention than formerly has been paid to economy in the melting and use of glue. As a result copper has been adopted in many factories where formerly iron was used for the melting vessels; water jacketted heaters have become universal; the glue tanks are kept covered to prevent evaporation, and thermometers are used to check the overheating of glue. All these improvements have brought increased economy.

The glue dissolver and filter consists of a soaking tank,

a converting vessel, and the melting chamber. The converting vessel is placed in the soaking tank and dry glue and water are put into the converting vessel. Care should be exercised in getting the correct proportions of water and glue. The glue should be weighed and the water measured after the weight of the amount to be measured has been determined. Glue should be allowed to absorb as much water as can consistently be used. After the glue has been soaked for the requisite length of time (ground glue about twelve hours; flake or cake glue twelve to fourteen hours) it will be ready to be placed in the glue dissolver.

In this way the glue takes up every particle of water it can hold and will give more "spread" than if it is stirred into the hot water and cooked immediately. Steam is introduced to melt the glue, and the contact of the steam with the exterior surface of the copper converting vessel, immediately raises the temperature of the glue jelly to melting point, and it pours steadily through the screen in the bottom of the converting vessel into the retaining chamber underneath, if so fitted, or otherwise into a glue spreading machine or bucket placed to receive it. A thermostatic valve to control the amount of heat or such other device as will insure cooking without excessive heat for any length of time, should be used. Heat should never be over 170° Fahrenheit, and when the glue is dissolved, the heat should be lowered to 180°.

Live steam should not come in contact with animal glue, nor should the glue be made in such quantities that it will be subject to continuous heat for long periods. Glue for banding or gumming work and the like should be comparatively slow-setting, free from acids that discolour or fade the paper, and, when used on any continuously running machine, not liable to foam. When glue is too "tacky" or sets too quickly an increase in the temperature or the addition of water may help to improve the condition. The addition of a teaspoonful of neat's foot oil to one gallon of liquid will help to retard quick setting. Foaming may be due to too much heat or to the fact that the glue

is acid or has become rancid by being permitted to stand too long in solution. The addition of approximately 8 per cent. of vegetable tallow to the quantity of dry glue in solution will tend to overcome the difficulty. Acid or rancid glues can be sweetened by the addition of a few drop of Lycol.

There is also obtainable a glue heater, which is air-tight to keep out dirt and dust and to reduce the formation of scum on the surface or crust on the sides. It prevents odours and steam from escaping, and also prevents glue from thickening and going sour. The saving by prevention of evaporation is very large, and the glue is drawn from the gate as wanted; not dipped or poured, with the resultant spilling. A gas heating arrangement, or steam, can be used. The agitator thoroughly stirs and mixes the glue to break up the lumps, and the best results are obtained by soaking the glue in cold water before being put into the heater. In the mixer and cooker, or other similar device, either hot or cold adhesives can be prepared.

Adhesives for Special Processes.

General Work.—A dry powder gum is frequently found suitable for most kinds of either machine or hand made box work, as well as for bottle labelling, carton sealing, etc. It should be economical in its water-taking qualities, not require cooking in preparation, and leave no sediment. For food packing it should be odourless and innocuous to human digestion, and it should keep indefinitely. In preparation, if one pound of gum requires, say, 2 lbs. of water for banding machines, it will only require 1½ lbs. of water for label gumming machines. The quantity of water should be varied to suit special requirements. In mixing the powder is generally added to the water, and stirred until dissolved. The mixture is then allowed to clear for a few hours by standing, and it can be used either when cold or warm. Similarly either cold or warm water may be used for mixing, though the warmer the water the quicker most such powders dissolve.

Box Ending.—For use on box ending machines dry gums should be very economical in use. For example, one pound of a certain make of this gum is sufficient for ending 4,000 boxes, or 8,000 ends 5 in. by 3¼ in. It does not require cooking and is used cold. In this particular instance the method of preparation is to take one pound of the gum to 2 lbs. of cold water, and to stir until the gum is thoroughly dissolved, after which it is ready for use. The resultant liquid may appear to be thin and watery with apparently little tack, but this, however, is its proper condition.

Banding and Labelling.—If the gum is in powder form and is suitable for banding and topping, and labelling, in either hand or machine work, it should combine the adhesive qualities of a good dextrine with greater water-taking qualities. It is generally lighter in colour. To prepare for use one pound of this gum should be added to about 5 lbs. of cold water, and after stirring should be heated up to a temperature of 170° F. in jacketted pans. When this temperature is reached throughout the mixture, the heat may be shut off. This gum can also be used either cold or warm. Other gums of a similar character and which may be used for very much the same class of work, particularly for hand and machine labelling, are adapted for paste making if they give a good tack. One pound of this kind of gum, stirred up in 4 lbs. of cold water, should be heated up to 170° F. in a jacketted pan, and prepared similarly. The liquid is then ready for use and may be used either hot or cold.

Liquid Glues.—For all classes of box and bag making, and labelling, both hand and machine work, liquid glues are made which, as general all-round adhesives, have much to recommend them. An advantage of this kind of glue is, of course, that it requires no cooking and is therefore always ready for use. For carton work the glue should dry more quickly and with a stronger tack, and should therefore be of heavier consistency. In order to prepare this glue for use, all that is required is to break the concentrated liquid

down with cold or warm water to suit the particular requirements, the average quantity of water added being 40 to 50 per cent. of the weight of glue used.

Tin Labelling.—There are specially prepared gums for use in sticking labels on to tin or other metal containers. One gum is supplied in powder form and holds absolutely fast in hot or cold climates, does not stain with rust marks nor discolour coloured labels. These gums must be submitted to severe tests by steam and heat, to show if they can withstand them successfully. To prepare for use, one pound of this gum powder should be stirred up in 6 lbs. of water and heated in a jacketted pan up to 170° F. until thoroughly heated throughout. The heat should then be shut off and the liquid allowed to cool, after which the gum is ready for use. It should be noted, however, that with these particular gums it is advisable only to mix sufficient for three or four days' work at a time. Gums, with similar properties and for the same purpose, are also obtainable for the use of those firms who have no proper heating apparatus. These gums are sent out already mixed and only require, to be ready for use, to be mixed with cold or hot water. All that is required to prepare these gums is to add an additional quantity equal to its weight, and the mixture then thoroughly stirred. The water added may be either hot or cold.

Dextrines.

Dextrine or British gum, which is the foundation of many, if not all, of the cold glues on the market, is prepared from starch, either potato, maize, or sago, generally by the action of dilute acid. The starch is moistened with very dilute nitric acid, well kneaded, made up into balls, and dried in hot air. It is then powdered up and spread in thick layers on brass trays in an air oven heated to about 280° F. Sulphuric and hydrochloric acids are used by some manufacturers, and in another method the starch is digested with crushed green malt. One of the more

recent processes uses buttermilk, sour milk or lactic acid. In appearance dextrine is a light yellow brown powder, though sometimes it is met with also pure white, but it is commonly agreed that the darker coloured varieties are more soluble in water and give a stronger glue.

Commercial dextrine is frequently adulterated, the most common additions being sand, gypsum, heavy spar and talc. A first-class quality should contain 70 to 73 per cent. dextrine soluble in water, 5 to 6 per cent. moisture, 8-9 per cent. grape sugar, and not more than 0.5 per cent. ash, the remainder being insoluble starch. The amount of sugar in dextrine is perhaps not very important; the test is carried out by means of copper acetate solution, and not with Fehling solution, as is usually employed in testing for sugars. Moisture, is naturally of importance, as nobody wishes to buy water and pay exorbitant rail charges upon it when dextrine is required. The usual method employed is to put two or three grams into a weighed U-tube which is kept in an oil-bath at 100° C. while dried air is passed through. The loss in weight gives the amount of moisture present.

The insoluble matter in dextrine very seriously affects its utility and should be always estimated. 50 grams of dextrine should be dissolved in 500 cc. of water and filtered on a dried, weighed, filter paper. The residue, on being dried at 100° C. and weighed gives the total insoluble matter present. This residue is then transferred to a weighed crucible and incinerated. The ash tells how much sand, etc., has been put in, and the difference in weight between the ash and the total insoluble matter gives the amount of unchanged starch present. 12-18 per cent. is found in a good quality dextrine, but in poor consignments this is sometimes as high as 80 per cent.

The greater part of dextrine manufactured in England comes from the Manchester district: America and Holland supply large quantities of both starch and dextrine. When making up solutions of dextrine for use in container making it is advisable to add a small quantity of preservative as

there is a tendency for the mixture to go mouldy. Oil of cloves is efficient and pleasant to work; a few cubic centimetres to the gallon should be added while the liquid is still hot before setting aside to cool. Very economical in use because their cost is generally low, their preparation simple, and their sticking qualities good, dextrines are found to have manifold uses in very many industries including the box making industry. There are many dextrines on the market, but the ordinary yellow powder dextrine is found to be useful in all kinds of box making, and for labelling purposes.

To make this powder ready for use one pound of dextrine should be mixed with one pound of cold water and stirred until dissolved. This should be sufficient for ordinary purposes, but if the mixture be heated in a jacketted pan up to 180° F. a much clearer, stronger, and tackier gum results. It is not necessary to continue the heating after the above temperature is reached. The resultant gum can be used either hot or cold. Other dextrines which are not so tacky are frequently employed in the manufacture of pastes, in conjunction with other ingredients, such as pearl starch, etc., for use in lithographic and similar work, or they are employed in textile industries for sizing and filling purposes. The average mixture is one pound of the powder with 1½ lbs. of cold water and, after stirring, heated in a jacketted pan up to 180° F. It is then ready for use.

§ 14

PROOFING MATERIALS

VARIOUS materials have been invented with the object of making all paper containers, though chiefly paper boxes for the packing of foodstuffs, waterproof and also innocuous as far as human consumption and taste are concerned. The most satisfactory of these materials may be classified into three groups: waxes, synthetic resins and metallic films. Other substances have been tried with more or less success, and there still is room for the discovery of a proofing material which will be so impervious to the high temperature of boiling jam or other preserves, that it will prevent the liquid contents from percolating through the board of the box while being tasteless, odourless and harmless generally from an edible standpoint.

WAXES.

By far the most important substance in this first group is paraffin wax, which in the pure state is white or bluish white, and has neither taste nor smell. Paraffin becomes plastic at temperatures often considerably below its melting point, is dietetically inert, and is unaffected by water and aqueous solutions of salts, acids, and alkalis. It, however, yields to spiritous and oily substances, being slightly soluble in alcohol and ether, and more or less readily so in petrol, kerosene, turpentine, and the fixed and essential oils. Paraffin wax appears to be used extensively in England and the United States of America for imparting an impervious layer to the surface of the cardboard. A layer on the inner surface is easily applied by running the strip of cardboard

over a roller dipping in a hot bath of molten paraffin, and in practice this is found to facilitate the manufacture of the spirally wound container as the wax acts as a lubricant and so minimises the friction between the inner layer and the mandrel. Whilst surfacing in this way reduces the porosity of the cardboard towards dry and moist air, it is little protection against water.

If, however, the cardboard be impregnated thoroughly with wax so that all the pores are filled, it then becomes absolutely watertight, and will even resist hot water or jam more or less satisfactorily. To obtain the best results, it is necessary that the right amount of paraffin be absorbed to fill all the pores without any excess remaining on the surface. Experiments made with moderately calendered strawboard showed that these conditions were fulfilled when the board had absorbed about half its weight of wax. But with cardboards of closer texture much lower proportions were taken up, as the following examples illustrate:—Fibreboard, 40 per cent.; paperboard, 33 per cent.; pulpboard, 25 per cent.

The temperature of the bath of molten paraffin, and the time of immersion of the cardboard in it, require careful adjustment with varying qualities of paraffin and cardboard, for while thorough impregnation is desirable, unduly prolonged immersion is dangerous. It would appear that the capillary attraction of the cardboard for the liquid wax is greater than for glue, and the intruding wax will, unless it be rapidly cooled, actually separate the cardboard fibres from the glue holding the several ply together, and these will then tend to come apart. This effect is more serious in the case of spirally wound bodies, and where they are intended for impregnation with wax it is necessary that the glueing operation shall have been very perfectly controlled. High-grade paraffin is used extensively in England, and one formula indicates that a mixture of 80 parts of paraffin with 20 parts of Carnauba wax is employed as an impregnating agent.

Cardboard impregnated with paraffin will be found

suitable for all ordinary dry powders and foodstuffs, including many which cannot be packed in untreated cardboard, *e.g.*, baking and saline powders, and mustard. Surface treatment merely is probably insufficient for this class of goods. The use of hardening mixtures will be most useful for containers carrying weighty commodities such as treacle or other semi-fluids. The higher melting point mixtures become more necessary when the containers are to be filled with hot materials such as jam, or when they are to be sent to inland country towns or the tropics where the temperatures in windows or on shelves exposed to the heat of the sun may easily reach the softening point of low melting point paraffins. In short, cardboard containers thoroughly impregnated with paraffin will be impervious to moist air and waterproof, not impart any objectionable colour or taste to the contents, permit of the packets being hermetically sealed, and withstand moderately high temperatures, especially if the paraffin be fortified by high melting point waxes.

Synthetic Resins.

A great deal of experimental work has been done in laboratories all over the world concerning the production of synthetic resins, and particularly with the various condensation products of phenol or cresols and formaldehyde. In the Chemistry Department of the University of Melbourne the lines of investigation suggested by the publications of Dr. L. R. Baekeland, whose name is identified with these substances, have been followed up. In America these synthetic resins are generally known as Bakelite, and large factories exist both in America and Europe for their manufacture into a variety of articles in which chemical inactivity and electrical resistance are of importance.

The reaction takes place spontaneously, and a mixture of cresol and formalin (a dental preparation known as formo-cresol) after some months' standing is often found to have reacted with the separation of an "oily" layer of

liquid resin. While this rate of action is too slow to be of any commercial value, it can be accelerated by raising the temperature and still more effectively by the addition of a catalyst such as either an acid or an alkali. Another class of varnish which has been given the name "Magramite" to distinguish it from the many forms in which Bakelite products have been put on the market for other purposes, has been found useful in Australia.

This requires approximately four parts of carbolic acid to three of formalin. In the application of magramite varnish to cardboard containers several problems arise. It was found that, as cardboard is a porous material, the varnish, like most other liquids, is greedily absorbed until the pores are filled. If a cardboard cylinder, made by the processes already described and intended to be used for making up into a container, be dipped into the varnish for a few seconds, the adhering coat will soon soak in and will not sufficiently protect the surface of the board. When this cylinder is dried out, and the Bakelite converted into the insoluble form by heat (stoving), it will be again able to absorb almost as much as on the first occasion.

It is only after several dippings and stovings that the varnish will cease to be absorbed and will merely form an additional film on the surface. The result is that the weight of dry resin picked up in the case of a 1½ lb. jam container body amounts to some 26 grammes, or over 75 per cent. of the weight of the original cardboard, although of this 26 grammes only about 2 grammes are actually required to cover the surface itself.

This thoroughly impregnated cardboard is practically a solid mass of Bakelite, with a beautiful, absolutely impervious glazed surface, but its cost puts it out of the running for containers, which are to be used once only and then cast away. The same objection applies to any proposal to incorporate Bakelite, either in the form of a varnish of *per se*, with paper pulp or any other fibrous foundation to produce a mass which can be moulded into containers for universal use. The alternative to complete impregnation

is to give the cardboard a superficial layer only, provided that the mechanical properties of the container thus constructed are equal to trade requirements. Several attempts have been made to reduce the porosity of the cardboard, and so prevent the varnish disappearing below the surface.

METALLIC FILMS AND OTHER METHODS.

There are two methods of applying a metallic film as a proofing material : one is to line the box or other container with a metal surfaced paper, and the other is to give the paper or cardboard a coating of tinned or other metallic paint. Some excellent metal coated papers are obtainable both in sheets and reels, and a water or greaseproof quality can be added to the paper, if so specified. For round containers, however, the fixing of the coated paper to the board is a difficult process if cockling is to be avoided. If a metallic film is used preference should be given to liquid coating.

Sodium silicate (waterglass), which is used in the paper and cardboard industry in other connections, was looked upon as a promising material, and a number of experiments, made with varying strengths of waterglass solution, did, indeed, give a non-absorbent foundation for the varnish, and at the same time increase both the hardness and strength of the cardboard. As against this, the application of the waterglass invariably caused the cardboard to buckle when it dried, and as its hygroscopic properties showed up even after coating with magramite, the finished product absorbed moisture and lost its enhanced rigidity. The use of waterglass has therefore to to be discarded until this difficulty can be overcome.

Casein has also some qualities which recommend it as an attractive field for experiments. The possibility of dissolving proteins in water or alkaline salt solutions, and of rendering them more or less insoluble by treatment with various agents such as formalin, potassium, dichromate, tannic acid, etc., has made this compound suitable as a

proofing material. The objections to using it, howeve for containers holding hot foodstuffs, are that the insolu bilizing agents so far discovered do not render the casei quite impervious either to heat or moisture, and furthe investigation is necessary before this material will b successful commercially. Apparently, there has not ye been devised any preparation for proofing more suitabl than paraffin wax and its associated compounds.

§ 15

ORGANISING THE FACTORY.

Before any manufacturing business is commenced it is essential that its foundations should be thoroughly sound. The smooth running of a factory depends upon the harmony with which each department works in relation to the whole, and this in turn demands not only a careful planning for the installation of the machinery required, but also every possible consideration for the working conditions of the labour employed. The very complex nature of almost every kind of paper container manufacture has made organisation the only sure road to success.

Competition, added to the now practically universal demand for paper boxes and bags in one form or another, has compelled the trade to emerge from the obscurity of the small, hand-labour days to the prominence which huge factories and an extensive employment of labour brings in its wake. Machinery has become indispensable, and it may be found that a forced economy in its purchase may result in a considerable expense in its running. The first axiom is, therefore, that every machine required should be bought with more of an eye to durability and reliability than to cheapness. That is why it pays to buy plant from a responsible engineering house.

It should be remembered that a machine may be erected satisfactorily and work well for a time, but that, through no fault of its own—too frequently because of inexperienced handling—something goes wrong. A reliable machinery house can then be called in for expert advice and

help. The mere fact that a machine has been bought and paid for should not mean that the engineering firm's interest in the purchaser has ceased or even lapsed for the time being.

MACHINERY INSTALLATION.

When it is decided that new plant requires to be laid down, the first consideration should be how to save time, labour, and space in operation. This will depend upon the factory area reserved for the plant plus the existing system of power distribution (such as shafting, etc.) and the relation of the new work to the old. When machinery for an entirely different branch of the trade is required, this part of the organisation is simpler, but in both cases the engineering firm should be consulted *first* on this point.

Some of the best machinery concerns even prepare plans to show where the plant can be installed to best advantage, and even if this method entails additional cost to the purchaser, it will be found cheaper in the end. Not only are there considerations of power distribution, but an important one is that of lighting. As every factory owner knows only too well, natural light is infinitely preferable to the artificial. In cases where the latter must be used, care should be taken that the essential operating part of the machine is illuminated without inflicting any strain upon the sight of the operator.

Another consideration of value, particularly in the paper and board working industries, is the care of delicate mechanisms. Certain machines, such as those which perform cutting operations, disperse a quantity of dust, and chiefly because of the fibrous quality of paper and board. Such mechanisms should be removed as far as is practicable from those in which adhesives or moisture of any kind are used. Above all, a competent mechanic should be employed. It is hopeless to expect a worker, however skilled, to remedy a machinery defect, and this applies chiefly to the experienced worker who understands what a machine

is capable of doing. Such workers always have a tendency to "patch up" a slight fault. This tendency should be checked at once, or, in the majority of cases, it will mean perhaps a twelve months' life for a machine which should live for twelve years.

Costing.

Having organised the installation of plant satisfactorily and being equipped suitably with both material and labour, the next point for consideration is the relation of cost of production to selling price. However else well organised a factory may be, without a reliable costing system the value of the whole is nullified. Various schemes have been and are still being evolved for the paper box and bag making industries with the object of arriving at a serviceable costing system, but without entering into too much detail a general scheme for such a system, as suggested by the National Paper Box Manufacturers' Association of U.S.A., will be sufficient to set down a guiding principle for all the paper container making industries.

This system is based upon the following formula : Prime Cost plus Manufacturing Expenses plus Selling Expenses equals Cost; and Cost plus Profit equals Selling Price. Each main heading covers various sub-headings, thus : Prime Cost includes Materials plus Productive Labour; Manufacturing Expense includes Building or Rent Charges plus Interest and Depreciation plus Power, Insurance, Repairs, Light and Heat plus Non-Productive Labour plus Commercial Charges; Selling Expense includes Counting House Charges plus Delivery Expense. Each of these Subheadings are then classified in detail as follows :—

Materials include Board, Lining, Stay Paper, Cover Paper, Fly Paper, Trim, Edging, Hinges, Labels, Printing, Glue, Packing Paper, Twine or Gummed Tape, Cases or Crates ;

Productive Labour includes Time or Piece Work, Bonuses, etc. on Board Cutting, Paper Cutting, Corner

Cutting, Bending, Staying, Stitching, Ending, Banding, Turning in, Topping and Bottoming, Wrapping or Covering, Fly-leafing, Labelling, Glueing-up, Hingeing, Thumb-holing, Finishing, Binding. Building or Rent Charges include Rent, Rates, Taxes, Repairs, Insurance, Depreciation, and Interest on Property Investment;

Interest and Depreciation include Repairs and Maintenance of Plant and Effects, Insurance and Investment Interest on Stock, Plant and Fixtures, Departmental Expenses, Storage for Raw and Finished Stock; *Power, Light and Heat, etc.*, include Labour, Wiring, Belting and Shafting Repairs, and Fuel or Power; *Non-productive Labour* includes Manager, Foremen or Forewomen, Cleaners, Stock-keepers, Messengers; *Commercial Charges* include Management Salaries, Office Equipment, Postage, Telephone, Petty Cash, Income Tax, Legal Expenses, Interest on Working Capital represented in Accounts Receivable; *Counting House Charges* include Salesmen's and Clerical Staff Salaries and Commissions, Travelling and Advertising Expenses, Bad Debts, Donations; *Delivery Expense* includes Interest, Maintenance and Depreciation on Horses, Wagons, Cars and Miscellaneous Costs, Drivers, Van Boys, Shippers.

All these items make up the Cost. These, all allocated properly, to which should be added a fair Profit, will give the proper Selling Price. With such a system there is no reason why any paper container making business should not develop into a successful undertaking.

Labour Conditions.

In very large paper box and bag making factories of to-day it has been found of immense value to the whole business if the conditions under which the employees work are comfortable. As so much female labour is required in these trades, special care must be given to the extra needs of that sex. In the factory room the question of ventilation is an indispensable necessity. Certain firms have even installed a modern ventilating plant to keep the air fresh and healthy. Another point is that the operators

who work in one particular position the whole day should have special seating contrivances to relieve them of weariness. No worker can do her work properly when she is tired.

Outside the factory room, wherever the opportunity presents itself, a room should be set aside for rest. The feminine temperament is unable to remain keyed up to such a useful pitch as the masculine, and hysterical workers affect those who are not so at the moment. It is wiser to give one or other of the workers who need it an hour or so of rest during a working day than to encounter a week's sickness or an unsettled workroom. For this purpose, where a forewoman is employed, she should have some knowledge of first aid. In large factories it pays to employ a feminine health superintendent.

The question of food is also important. It is notorious that the feminine working class appears to have no sound idea of bodily nourishment. Since the factory owner would not tolerate for a moment the use of fuel for his motor power which is expensive and yet destructive to his engines, so he should not permit, as far as lays in his power, the productive mechanism of his workers' bodies to suffer likewise. Even in comparatively small factories this evil can be avoided by the establishment of an indoor kitchen. This may appear too big an undertaking for most paper container making houses, but if the question is carefully considered the difficulties will quickly disappear. The advantages are enormous.

Finally, the employer should encourage in his workers other mutual interests besides that of work. An occasional festive evening in the winter months, coupled with two or three summer outings, proves a valuable investment. It will even be found that most workers are willing to subscribe among themselves for such enjoyments, so that a donation from the firm is all that is needed. Both outdoor and indoor sports should be developed, and those firms who wish to be ambitious will find classes of instruction a useful asset to the making of skilled workers.

By organising the business along such lines—and this applies to the small as well as to the large concern—not only will the workers be happy and loyal, but economy plus efficiency will crown a maximum output of work. These points will, of course, require individual treatment according to the conditions obtaining in each factory, but before any firm engages in the manufacture of paper containers in general, and even those firms who are already in the trade, the utmost attention should be paid to factory organisation.

§ 16

BOXBOARD CALCULATION.

The following tables give the approximate number of sheets to the cwt. in various kinds and sizes of cardboard used in the manufacture of paper boxes. Common usage has differentiated between Strawboard and other varieties of Boxboard inasmuch as the sheet thickness of the former is described by weight and of the latter by caliper.

Unlined Strawboard.

The standard size is 22 by 32 inches. The caliper (decimal point of an inch) of the various weights is as follows :—4 oz. = ·011 ; 6 oz. = ·017 ; 8 oz. = ·023 ; 10 oz. = ·029 ; 12 oz. = ·035 ; 14 oz. = ·041 ; 16 oz. = ·046 ; 18 oz. = ·052 ; 20 oz. = ·059 ; 22 oz. = ·064.

Size Inches.	4-oz.	6-oz.	8-oz.	10-oz.	12-oz.
22 × 32	448	299	224	179	149
20 × 30	524	350	262	210	175
22 × 34	422	281	211	168	140
22 × 36	398	265	199	159	132
22½ × 28	500	334	250	200	167
24 × 32	410	274	205	164	137
24 × 38	345	230	172	138	115
25 × 30	420	280	210	168	140
25 × 36	350	233	175	140	116
25 × 40	315	210	157	126	105
26 × 32	379	252	189	151	126
26 × 38	319	213	159	127	106
27 × 34	343	229	171	137	114
28 × 36	312	208	156	125	104
28 × 39	288	192	144	115	96
29 × 38	286	191	143	114	95
30 × 40	262	175	131	105	87
32 × 39	252	168	126	100	84
32 × 44	224	149	112	89	74

UNLINED STRAWBOARD.

Size		Inches.	14-oz.	16-oz.	18-oz.	20-oz.	22-oz.
22	×	32	128	112	99	89	81
20	×	30	150	131	116	105	95
22	×	34	120	105	93	84	76
22	×	36	113	99	88	79	72
22½	×	28	143	125	110	100	90
24	×	32	117	102	90	82	74
24	×	38	98	86	76	69	62
25	×	30	120	105	93	84	76
25	×	36	100	87	77	70	63
25	×	40	90	78	69	63	57
26	×	32	108	94	83	75	68
26	×	38	91	79	70	63	57
27	×	34	98	85	75	68	62
28	×	36	89	78	69	62	56
28	×	39	82	72	64	57	52
29	×	38	81	71	63	56	51
30	×	40	75	65	58	52	47
32	×	39	72	63	56	50	45
32	×	44	64	56	49	44	40

Size		Inches	1½-lb.	1¾-lb.	2-lb.	2¼-lb.	2½-lb.
25	×	30	70	60	52	46	42
21	×	26	96	82	71	63	57
22	×	32	75	64	56	49	45
24	×	38	57	49	43	38	35
27	×	34	57	49	42	37	34
25	×	40	52	45	39	34	32
28	×	36	52	44	35	34	31
30	×	40	43	37	32	28	26

Size		Inches.	2¾-lb.	3-lb.	3½-lb.	4-lb.
25	×	30	38	35	30	26
21	×	26	52	48	41	35
22	×	32	40	37	32	28
24	×	38	31	28	24	21

Size	Inches.	2¾-lb.	3-lb.	3½-lb.	4-lb.
27 ×	34	31	28	24	21
25 ×	40	28	26	22	19
28 ×	36	28	26	22	19
30 ×	40	23	22	18	16

To find the approximate weight of any size in a given substance multiply length and width for area and divide: 8 oz. by 88; 10 oz. by 70½; 12 oz. by 58; 14 oz. by 50; 16 oz. by 44; 18 oz. by 39; 20 oz. by 35; 22 oz. by 32; 1½ lb. by 29; 1¾ lb. by 25; 2 lb. by 22; 2¼ lb. by 19½; 2½ lb. by 17½; 2¾ lb. by 16; 3 lb. by 14½; 3½ lb. by 12½; 4 lb. by 11.

LEATHERBOARD.

The standard size of leatherboard is 24 by 38 inches, or 61 by 96 centimetres. Board thickness is denoted by caliper and not by weight. The figures at the head of each column represent the caliper of the sheet indicated.

Size of Sheet. Inches.	c/ms.	·160	·132	·101	·080	·066
24 × 38	61 × 96	25	30	40	50	60
24 × 32	61 × 81	29	35	47	59	71
26 × 38	66 × 96	23	27	37	46	55
27 × 35½	68½ × 90	23	28	38	47	57
28 × 39	71 × 99	21	25	33	42	50
28 × 40	71 × 101½	20	24	32	40	48
28 × 41	71 × 104	19	23	31	39	47
30 × 37	76 × 93½	20	24	32	41	49
30 × 40	76 × 101½	19	23	30	38	46
30 × 41	76 × 104	18	22	29	37	44
30 × 43	76 × 109	17	21	28	35	42
31½ × 43¼	79½ × 109½	17	20	27	34	41
32 × 39	81 × 99	18	22	29	36	44
32 × 44	81 × 111½	16	19	26	32	38
32 × 45½	81 × 115	15	18	24	31	37

Leatherboard.

Size of Sheet. Inches.	c/ms.	·058	·050	·045	·040	·036
24 × 38	61 × 96	70	80	90	100	110
24 × 32	61 × 81	83	95	107	119	130
26 × 38	66 × 96	64	73	83	92	101
27 × 35½	68½ × 90	66	76	85	95	104
28 × 39	71 × 99	58	66	75	84	92
28 × 40	71 × 101½	57	65	73	81	89
28 × 41	71 × 104	55	63	71	79	87
30 × 37	76 × 93½	57	65	74	82	90
30 × 40	76 × 101½	53	61	68	76	83
30 × 41	76 × 104	52	59	67	74	81
30 × 43	76 × 109	49	56	63	70	77
31½ × 43¼	79½ × 109½	47	54	61	68	74
32 × 39	81 × 99	51	58	65	73	80
32 × 44	81 × 111½	45	51	58	64	71
32 × 45½	81 × 115	43	50	56	62	68

Size of Sheet. Inches.	c/ms.	·033	·031	·029	·027	·025
24 × 38	61 × 96	120	130	140	150	160
24 × 32	61 × 81	142	154	166	178	190
26 × 38	66 × 96	110	120	129	138	148
27 × 35½	68½ × 90	114	123	133	142	152
28 × 39	71 × 99	100	108	117	126	133
28 × 40	71 × 101½	97	105	114	122	130
28 × 41	71 × 104	95	103	111	119	127
30 × 37	76 × 93½	98	106	115	123	131
30 × 40	76 × 101½	91	98	106	114	121
30 × 41	76 × 104	88	96	104	111	118
30 × 43	76 × 109	84	92	99	106	113
31½ × 43¼	79½ × 109½	81	87	94	101	107
32 × 39	81 × 99	87	95	102	109	117
32 × 44	81 × 111½	77	84	91	97	103
32 × 45½	81 × 115	75	81	87	93	100

Size of Sheet. Inches.	c/ms	·023	·022	·021	·020
24 × 38	61 × 96	170	180	190	200
24 × 32	61 × 81	202	213	225	237
26 × 38	66 × 96	157	166	175	184
27 × 35½	68½ × 90	161	171	180	190
28 × 39	71 × 99	141	150	158	167
28 × 40	71 × 101½	138	146	154	162
28 × 41	71 × 104	135	143	150	158
30 × 37	76 × 93½	139	147	156	164
30 × 40	76 × 101½	129	137	144	152
30 × 41	76 × 104	126	134	140	148
30 × 43	76 × 109	120	127	134	141
31½ × 43¼	79½ × 109½	113	120	127	133
32 × 39	81 × 99	124	131	138	146
32 × 44	81 × 111½	110	116	123	129
32 × 45½	81 × 115	106	112	118	125

Woodpulpboard.

The standard size is 22 by 32 inches, or 55½ by 81 centimetres. As in the case of leatherboard, the thickness of the sheet is denoted by caliper and not by weight.

It will be noticed in this section that in certain instances two or more columns of sheet count to the cwt. have the same caliper heading. This is due to the possible variations of the different grades obtainable.

Size of Sheet. Inches	c/ms.	·112	·094	·080	·070	·062
22 × 32	55½ × 81	50	60	70	80	90
20 × 25	50½ × 63	70	84	99	113	127
20 × 30	50½ × 76	59	70	82	94	106
24 × 38	61 × 96	39	46	54	62	69
25 × 40	63 × 101	35	42	49	56	63
27½ × 39½	70 × 100	32	38	45	51	58

WOODPULPBOARD.

Size of Sheet. Inches.	c/ms.	·056	·050	·047	·043	·040
22 × 32	55½ × 81	100	110	120	130	140
20 × 25	50½ × 63	141	155	169	183	197
20 × 30	50½ × 76	117	129	141	153	164
24 × 38	61 × 96	77	85	93	100	108
25 × 40	63 × 101	70	77	84	91	98
27½ × 39½	70 × 100	65	71	77	84	90

Size of Sheet. Inches.	c/ms.	·037	·035	·033	·031	·029
22 × 32	55½ × 81	150	160	170	180	190
20 × 25	50½ × 63	211	225	239	253	268
20 × 30	50½ × 76	176	188	199	211	223
24 × 38	61 × 96	116	124	131	139	147
25 × 40	63 × 101	105	112	119	126	133
27½ × 39½	70 × 100	97	104	110	116	123

Size of Sheet. Inches.	c/ms.	·028	·026	·025	·024	·023
22 × 32	55½ × 81	200	210	220	230	240
20 × 25	50½ × 63	282	296	310	324	338
20 × 30	50½ × 76	235	246	258	270	282
24 × 38	61 × 96	154	162	170	178	185
25 × 40	63 × 101	140	147	154	161	169
27½ × 39½	70 × 100	129	136	143	149	155

Size of Sheet. Inches.	c/ms.	·022	·021	·020	·020	·019
22 × 32	55½ × 81	250	260	270	280	290
20 × 25	50½ × 63	352	366	380	394	408
20 × 30	50½ × 76	293	305	317	329	340
24 × 38	61 × 96	193	201	208	216	224
25 × 40	63 × 101	176	183	190	197	204
27½ × 39½	70 × 100	162	168	174	181	188

Size of Sheet. Inches.	c/ms.	·018	·017	·016	·016	·016
22 × 32	55½ × 81	300	310	320	330	340
20 × 25	50½ × 63	422	436	451	465	479
20 × 30	50½ × 76	352	364	375	387	399
24 × 38	61 × 96	232	239	247	255	262
25 × 40	63 × 101	211	218	225	232	239
27½ × 39½	70 × 100	194	201	208	214	220

Size of Sheet. Inches.	c/ms.	·016	·015	·015	·014	·014
22 × 32	55½ × 81	350	360	370	380	390
20 × 25	50½ × 63	493	507	521	535	549
20 × 30	50½ × 76	411	422	434	446	458
24 × 38	61 × 96	270	278	286	293	301
25 × 40	63 × 101	246	253	260	267	274
27½ × 39½	70 × 100	227	233	240	246	253

Size of Sheet. Inches.	c/ms.	·014	·013	·013	·012	·011
22 × 32	55½ × 81	400	410	430	450	470
20 × 25	50½ × 63	563	577	605	634	662
20 × 30	50½ × 76	469	481	505	528	551
24 × 38	61 × 96	309	316	332	347	363
25 × 40	63 × 101	281	288	302	316	330
27½ × 39½	70 × 100	259	266	279	292	305

Size of Sheet. Inches.	c/ms.	·011	·011	·010	·009
22 × 32	55½ × 81	490	500	550	600
20 × 25	50½ × 63	690	704	774	845
20 × 30	50½ × 76	575	587	645	704
24 × 38	61 × 96	378	386	425	468
25 × 40	63 × 101	344	352	387	422
27½ × 39½	70 × 100	318	324	356	389

§17. STITCHING WIRE EQUIVALENTS.

STITCHING wire is sold by weight either in wound coils or on wooden or iron spools. Most manufacturers used the British Imperial Standard Wire Gauge, though some houses adopt their own gauges. The following tables are based on the Standard Gauge measurements.

ROUND WIRES.

Gauge.	Inches.	M/Metres.	Feet per lb.	1 in. stitches per lb.
18	·048	1·219	167	2,004
19	·040	1·016	250	3,000
20	·036	·914	300	3,600
21	·032	·813	376	4,512
22	·028	·711	493	5,916
22½	·026	·650	582	6,984
23	·024	·610	670	8,040
24	·022	·559	800	9,600
25½	·019	·482	1,080	12,960
26½	·0172	·430	1,305	15,660
28	·0148	·356	1,695	20,340

FLAT WIRES.

Gauge.	Inches.	M/Metres.	Feet. per lb.	1 in. stitches per lb.
12 × 25	·104 × ·020	2·642 × ·509	175	2,100
12 × 26	·104 × ·018	2·642 × ·457	184	2,208
12 × 28	·104 × ·0148	2·642 × ·356	202	2,424
12 × 32	·104 × ·0108	2·642 × ·274	250	3,000
13 × 28	·092 × ·0148	2·337 × ·356	[illegible]	3,360
20 × 22½	·036 × ·026	·914 × ·650	374	4,488
21 × 23½	·032 × ·023	·813 × ·584	415	4,980
21½ × 25	·030 × ·020	·761 × ·509	552	6,624
21 × 26½	·032 × ·0172	·813 × ·430	612	7,344
22 × 27½	·028 × ·0156	·711 × ·396	805	9,660

It should be noted that in the latter category the first five lines refer to what are known in the trade as Broad Flat Wires, and the last five lines to Narrow Flat Wires.

§ 18

GLOSSARY.

The following glossary of terms used in this volume has been classified alphabetically, with cross references, and indexed for the pages on which the reference appears. A column has been devoted to the insertion of the terms used in the accepted "Terminology" published by the National Paper Box Manufacturers' Association of U.S.A., so that the British terms used will be more readily understood in America.

Reference.	*American Term.*	*Page*
Adhesives	Adhesive	187
Adhesives for General Work		190
Adhesives for Tin Labelling		192
Animal Glue	Adhesive	187
Automatically Made Upright Covered Boxes	Set-up Box	32
Bag Papers		9
Bag Printing		178
Bags, Hand Made		157
Bags, Machine Made		165
Bakelite		197
Baling Press		19
Banding	Banding, Covering	27
Bending	Creasing	82
Block and Funnel Process (Bags)		164
Block Bottom Bags		162, 170
Board End Seaming for Round Boxes		118
Board Coating		111

Reference.	*American Term.*	*Page*
Conical Boxes		11, 109
Corner Cutting	Corner Cutting	18
Corner Cutting for Paper Wrappers	Paper Corner Cutting	84
Corner Staying	Staying	20, 100
Corrugated Board		6
Corrugated Board Boxes	Shipping Container	81, 102
Costing		208
Cover Paper	Papers	8, 26
Covering, for Hand Made Boxes	Covering	140, 147
Covering, for Upright Covered Boxes	Covering	26
Creasing and Slotting		84, 97
Cretonne Covering		152
Cutta Crush Work		96
Cutters		131
Cutting and Creasing Formes	Dies	64
Cutting and Creasing Presses	Cutting and Creasing Presses	69
Cutting and Creasing Rules	Rule	64
Cutting and Scoring	Scoring	16
Cutting for Hand Made Bags		159, 160
Cutting for Machine Made Bags		166
Crimped Cups		182
Cylinder Cutting and Creasing	Cutting and Creasing	70
Cylindrical Boxes		11, 109
Decorating Hand Made Boxes		140, 147
Dextrines	Adhesive	192
Doming	Doming	148
Edge Stripping	Trimming	29
Embossing	Embossing	64, 148
End-Pieced Box	Set-up Box	11, 21
End-Piecing	Piecing	21
End-Set Box	Set-up Box	22
End-Setting	Ending	22

O 2

Reference.	*American Term.*	*Page*
Hand Made Bags		157
Hand Made Boxes	Set-up Box	135
Hand Made Wrappers		164
Hand Scoring	Scoring	189
Hand Staying	Staying	140
Hingeing	Hinging	31, 141
Humidor		23
Inners, Paper Bag		171
Kite Shaped Bags, Hand Made		157
Kite Shaped Bags, Machine Made		169
Labelling Rectangular Boxes	Labelling	31, 142
Labelling Round Boxes	Labelling	124
Labelling Upright Covered Boxes	Labelling	81
Labour Conditions		204
Lacing	Lacing	31, 42
Laundry Bags		169
Leatherboard	Boxboard	8
Leatherboard Calculation		209
Lining Bags		171, 174
Liquid Glues	Adhesive	191
Lock Seam Bags		169
Loose Wrapping	Loose Wrapping	39
Machine Made Bags		165
Machine Made Boxes	Box	11
Machine Made Wrappers		174
Machinery Installation		202
Magramite		198
Metal Edging	Stay	91
Metal Topping and Bottoming		120
Metallic Films		199
Millboard	Boxboard	1[illegible]
Millinery Bags		169
Mitreing for End-Set Boxes	Mitering	22

Reference.	*American Term.*	*Page*
Pressed-out Caps		117
Printing on Bags		178
Printing on Carton Board		62
Printing on Carton Board (Rotary)		72
Printing on Fibreboard		96
Printing on Round Boxes		124
Proofing Materials		195
Pulp Moulded Boxes		128
Punches		181
Punching for Carton Work		75
Punching Press		130
Raw Material		1
Rectangular Hand Made Box	Set-up Box	137
Reel Fed Bags		168
Rivetting		91
Roll Sheet Cutting		27, 102
Rose Bottom Bags		170
Rotary Creasing and Slitting		98
Rotary Cutting and Bending		88
Rotary Printing, Cutting and Creasing		72
Rotary Slitting	Rotary Slitting	85
Round Board Cutting		148
Round Box		11, 109
Round Box Labelling		124
Round Box Printing		124
Round Hand Made Box	Set-up Box	142
Round Stitching Wire		214
Rule Bending		65
Satchel Bags		160
Scoring	Scoring	16, 189
Sealing Filled Bags		176
Sealing Filled Cartons		79
Seaming Board Ends		118
Seaming Tin Ends		120
Self-Opening Bags		168

Reference.	*American Term.*	*Page*
Tin End Seaming		120
Topping	Topping	80
Travelling Shear Attachment for Corrugated Board		7, 95
Tube Rolling		112
Tube Winding		115
Tubular Bags		177
Twine Sacks		181
Two-Piece Blank (Collapsible Box)	Blank	101, 108
Two-Piece Blank (Upright Covered Box)	Blank	15, 24
Unlined Strawboard Calculation		207
Upright Covered Box	Set-up Box	11, 15
Upright Wire Stitched Box	Set-up Box	81
Vegetable Glue	Adhesive	187
Washering		161
Waste, Baling		19
Waste Roll Re-winding		27
Waterproofed Board	Boxboard	7
Waterproof Paper		7
Waxes		105
Waxing for Round Boxes		111, 115
Weighing and Filling for Bags		175
Weighing and Filling for Cartons		79
Wire Stitched Collapsible Box	Shipping Container	11, 93
Wire Stitched Upright Box	Set-up Box, Shipping Container	11, 81
Wire Stitching	Staying	89
Woodpulpboard	Boxboard	5
Woodpulpboard Calculation		211
Wrapping	Wrapping	38, 86
Wrapper Cutting	Paper Corner Cutting	84
Wrapper Glueing	Stencilling	85
Wrapping by Machinery		174
Wrapping Plant Grouping		44

INDEX TO ADVERTISEMENTS.

The Raw Material, Machinery, Adhesives and Auxiliary Materials advertised in the following pages have been placed in separate sections, alphabetical order being followed as closely as possible. Each section is preceded by a classified index, as follows :—

RAW MATERIAL SUPPLY HOUSES.

Raw Material Supply Houses.

Raw Material Supply Houses.

Page

WOODPULPBOARDS.

WRAPPING PAPERS.


MODERN METHODS FOR MANUFACTURERS
INCLUDE—
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P 2

MACHINERY
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Machinery Supply Houses.

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